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INCREASED VISUAL BEHAVIOR IN LOW VISION CHILDREN.
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TEN PAIRS OF BLIND CHILDREN AGED SIX TO 13 YEARS WHO HAD SOME VISION WERE MATCHED BY PRETEST SCORES ON A TEST OF VISUAL DISCRIMINATION. A CRITERION GROUP, DESIGNATED THE PRINT COMPARISON GROUP, HAD SLIGHLY HIGHER RECORDED DISTANCE ACUITIES AND USED VISION AS THE PRIMARY MEANS OF LEARNING. PAIRS OF EXPERIMENTAL SUBJECTS DAILY RECEIVED 45 MINUTES OF TRAINING DESIGNED TO INCREASE FUNCTIONAL USE OF REMAINING VISION. SPECIFIC LESSON PLANS FOLLOWED THE FOUR SEQUENTIAL STAGES FOR DISCRIMINATION AND RECOGNITION OF VISUAL STIMULI--GEOMETRIC FORMS IN SOLID BLACK AND IN OUTLINE SHAPES, SINGLE OBJECT FORMS IN SOLID BLACK AND IN OUTLINE SHAPES, GROUPED OBJECTS IN COLOR AND IN OUTLINE WITH FULL INNER DETAILS, AND LETTER AND WORD SYMBOLS. MATERIALS GRADUALLY DECREASED IN SIZE. AT COMPLETION OF TRAINING SESSIONS SUBJECTS WERE AGAIN TESTED WITH THE TEST OF VISUAL DISCRIMINATION. ANALYSIS OF RESULTS SHOWED A STATISTICALLY SIGNIFICANT DIFFERENCE IN (1) TEST SCORES OF EXPERIMENTAL GROUP CHILDREN, (2) THE DIFFERENCE IN THE EXPERIMENTAL AND CONTROL GROUPS' MEAN GAINS AND (3) MEAN GAIN BETWEEN EXPERIMENTAL AND PRINT COMPARISON GROUPS. NEAR VISION ACUITIES INCREASED IN SEVEN OF THE TEN SUBJECTS, BUT MEAN INCREASE WAS NOT STATISTICALLY SIGNIFICANT, NOR WAS THERE A SIGNIFICANT DIFFERENCE BETWEEN THE TWO GROUPS. THE VISUAL DISCRIMINATION TEST YIELDED A TEST-RETEST STABILITY COEFFICIENT OF .98. APPENDIXES INCLUDE THE VISUAL DISRIMINATION TEST, THE 44 LESSON PLANS AND MATERIALS USED, RATING SHEET FOR DAILY PROGRESS, SUMMARIES OF EXPERIMENTAL GROUP SUBJECTS, AND RELEVANT CHARTS. REFERENCE LIST CITES 76 ITEMS. THIS DOCUMENT WAS PUBLISHED BY THE AMERICAN FOUNDATION FOR THE BLIND, 15 WEST 16TH STREET, NEW YORK, NEW YORK 10011, $1.50. (CG)

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By
Natalie Barraga, Ed.D.

Research Series No. 13

American Foundation for the Blind

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By Natalie Barraga Ed.D.

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FOREWORD

Eye specialists in recent years have recognized that the use of the eyes by children with very low vision will not cause damage nor decrease the degree of remaining vision. This discovery has led educators of blind children to give increased attention to the effective use of any remaining vision for educational purposes.

This monograph is based on a doctoral dissertation entitled "Effects of Experimental Teaching on the Visual Behavior of Children Educated as Though They Had No Vision", which was submitted to the Department of Education at George Peabody College for Teachers in 1963. The purpose of the study was to determine whether the visual behavior of blind children with remaining vision could be improved significantly by a short period of specialized instruction with appropriate materials. The subjects were children with extremely low degrees of remaining vision, who previously had received no specific instruction in visual discrimination and recognition of educational materials.

The American Foundation for the Blind appreciates the opportunity to add this pioneer study to the literature available for students in the field. We are sincerely grateful to Dr. Barraga for her permission to publish it.

M. Robert Barnett
Executive Director

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The contributions of many individuals were essential to the completion of this research. The writer wishes to express sincere appreciation to Dr. Samuel C. Ashcroft under whose direction the study was undertaken, to Dr. Allen Lawrence, consulting ophthalmologist, and to Misses Carol Halliday and Nancy Zimmerman, who gave their time in testing the children included in the study.

Special thanks are to be extended to the administration, staff, and participants of the Tennessee School for the Blind and the Illinois Braille and Sight-Saving School whose interest and cooperation permitted the writer to identify a highly selected group of children for this experimental study.

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INTRODUCTION

When special education provisions were first made for children with low degrees of vision, one basic purpose was to "save their sight" by the use of materials and methods which required minimal use of vision. Only recently have changes in this philosophy been reflected in educational practice. Eye specialists have increasingly encouraged the use of eyes, and suggested that even in most cases of pathological conditions, the use of the eyes will not cause damage nor decrease the degree of remaining vision. With this medical release, educators are increasingly focusing their attention on the effective use of any bit of remaining vision.

When young children are diagnosed as blind in terms of standard distance acuity measurements, there is a tendency to accept this as a valid basis for educational prognoses, even though the children may have potentially useful but undeveloped near point vision. By repeated observation of visual materials brought very close to the eyes or by use of enlarged materials, some children may develop considerable visual efficiency, even though the eye examination reveals no numerical index or a very low measurement of acuity (Bier, 1960). If little encouragement and no planned opportunities for the development and use of near vision are offered such children, they may encounter few experiences which stimulate the desire or the need for endeavoring to develop whatever vision they may possess.

Noting that some children with very low vision read print while others read braille, Jones (1961, p. 24) suggested that environmental factors may be very important "in encouraging or discouraging the child with very limited vision to put forth the necessary effort required to develop adequate visual skills."

The literature, teachers, and personal experience of the investigator suggest the need for educational research to determine whether or not some children with extremely low degrees of vision can learn, through a period of systematic teaching, to utilize vision in early educational experiences. Because of the gross lack of research related to this problem, educators often fail to motivate children to make low degrees of vision contribute to learning. Having no definitive means of appraisal, teachers have been required to depend on eye examination reports or to use trial and error methods in attempting to determine children's potential abilities in visual functioning.

The recognition of the limitations in knowledge of the educational value of low vision coupled with the need for controlled studies in the desirability of visual stimulation have provided impetus for this study.

Purpose

The purpose of this study was to determine if the visual behavior of blind children having remaining vision could be improved significantly by a short period of specialized instruction with appropriate materials. The subjects were children with extremely low degrees of remaining vision, who had previously received no specific instruction in visual discrimination and recognition of educational materials.

Definition of Terms

In order to orient the reader to the scope and limitations of the research, and to define the problem clearly, the following terms required definition:

Blind. The most frequently accepted definition of blind states:

> Central visual acuity of 20/200 or less in the better eye, with correcting glasses; or central visual acuity of more than 20/200 if there is a field defect in which the peripheral field has contracted to such an extent that the widest diameter of visual field subtends an angular distance no greater than 20 degrees (Kerby, 1940, p. 3).

Distance visual acuity. According to Ashcroft (1963b) the clinical recording of acuity as measured by the standard Snellen E distance chart is known as distance acuity.

Near visual acuity. For purposes of this study, near visual acuity was defined as the clinical recording of acuity measured by the Guibor Near Vision Chart* (adapted from the Snellen E distance chart). The symbols on the chart coincide with the size letters which the person with normal vision is expected to read at a distance of 14 inches. If, at 14 inches the person can read the symbol the normal eye can read at that distance, he is said to have 14/14 near visual acuity or the equivalent of 20/20 near vision, and 100% visual efficiency. A reading of 14/140 is equivalent to distance vision of 20/200 or 20% visual efficiency. If the individual can read the 14/140 symbol only when brought nearer the eye, the distance at which it is read is recorded in the numerator; e.g. 3/140 is equivalent to 20% visual efficiency at a point within three inches of the eye.

Residual vision. As used in this study residual vision was defined as any degree of vision which, though not describable in numerical terms, could be clinically described as light perception, object perception, or counts fingers, and was sufficient to enable the individual to discriminate and recognize visually suitable materials within his low vision range.

Remaining vision. The term remaining vision was used as an inclusive term to denote the degree of vision which includes both near point acuity and residual vision as defined.

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*A chart designed by Dr. George P. Guibor, Chicago, Illinois, which shows percentages of visual efficiency for reading various sizes of type. This chart is available from distributors of ophthalmic supplies.

RELATED RESEARCH

Introduction

Increased interest in the problems of children with visual impairments has been reflected in recent writings and reviews of research activities (Ashcroft, 1963; American Foundation for the Blind Research Bulletin, No. 2, 1962). More conference discussions and increasing numbers of proposed research projects give evidence of greater concern for the educational implications of limited visual functioning. The meager research to date tends to pose more questions and problems than to provide lucid answers to the visual behavior of children with remaining vision. Sixty per cent of the legally blind students registered at the American Printing House for the Blind in 1960 for use of special educational materials (Jones, 1961) were reported to have remaining vision in excess of light perception. Many of the students with recorded distance acuities of 5/200-20/200 were using print as their primary educational media, and some children with distance acuity so low that it was reported as "counts fingers" or "object perception" were also registered as print readers.

These and other data focus attention on some very pertinent questions for educators:

1. Has the lack of educational opportunity for visual experiences prevented the development of visual discrimination and recognition of materials which children with low distance acuity are actually able to see at a very near point?

2. Would a relatively short period of individualized teaching with appropriate educational materials increase the ability of some children to make more effective use of low vision?

3. Could differentiating individual characteristics be identified in qualitative assessment of functional vision among these children?

Eye specialists (Bier, 1960; Dorman, 1949; J. E. Lancaster, 1949; Sloan, 1956) stress the necessity of personal attention to each child with low vision; some children will have better near vision than distance vision, and vice versa; all children with low vision suffer from lack of visual stimulation, and may need to be taught visual forms, and be won over to the "world of seeing." Unless previous experiences have provided the child an opportunity to communicate in terms of his visual discriminations, he may be unable to utilize educational materials meaningfully. Regardless of how low the degree of remaining vision, visual experience should be provided in order to promote the use of visual materials in tactual, auditory, and related learning.

Little, if any, educational research has dealt with the personal characteristics or the visual behavior of children whose observations are limited to a range within a few inches of the eyes. Studies of the effects of visual training on the increase of visual efficiency have been carried on primarily with subjects who had muscular anomalies. Psychological experiments have been concerned with sensory deprivation and/or stimulation and speed of visual perception. Few studies of any nature have been based on theories of the behavioral aspects of seeing. Nevertheless, the findings which have been reported appear relevant to an integrated understanding of the physiological, psychological, and educational factors related to optimal visual functioning.

The following review summarizes briefly the developmental phases of vision in terms of maturation, and the ability to discriminate as a result of visual stimulation and visual training. The review of psychophysiological aspects of the visual process includes the consideration of visual acuity and efficiency, visual perception, and the nature and effects of physical and psychological deficits. The relation of visual efficiency to the reading process in general is examined, and the review is concluded with a discussion of the interrelation of organic defects and the reading behavior of children.

Developmental Aspects of Vision

Maturation. Visual functioning is an act and a process evinced by "an action system which has a structured form" and a lawful sequence of development (Gesell, Ilg, & Bullis, 1950). In the infant the process is subtle and swift, and the various physiological functions develop concurrently but not uniformly. Gesell views fixation as the basic visual function, whereas the other processes of focus, fusion, and unification are refinements in the process. The patterns of visual behavior are thought to continue their attempted growth toward optimal realization even when physical difficulties intervene. However, in children with severe anatomical defects, achievement of the "full measure of normal development" is opposed by the faulty structural condition of the end organ, and growth is hampered. Even though the basic structure must remain unchanged, experience and training may act as ameliorating forces in improving visual efficiency.

An English ophthalmologist (Law, 1960) followed closely the development of 14 infants who were suspected of being blind at or shortly after the time of birth. Only three of the children remained totally blind, whereas the 11 others showed distinct signs of improving visual acuity during the developmental years. Law postulated that 80% of babies suspected of being blind at birth eventually prove to have some useful vision. This suggestion is in keeping with Gesell's theory of continued growth and improvement of the visual processes through experience, even in the face of physical impairment.

Stimulation and discrimination. Experimental studies of animals reared in total darkness (Riesen, Chow, Semmes, & Nissen, 1951; Woodruff & Wickens, 1951) have revealed a gross lack of development of the visual processes and an absence of discrimination ability upon initial exposure to light. Although responses to visual patterns emerged over a period of time, the effects of the delayed development of visual processes were reflected in subsequent behavior. The deprivation of light prevented stimulation of visual receptors, and consequently prohibited the opportunity for experience in fixation and fusion, considered by Gesell to be the unifying aspects of visual functioning.

Analagous to the work of Riesen, et. al. with animals, Senden (1960) compiled published reports on congenitally blind persons (some of whom were children) whose sight had been restored by surgery. Objects were clearly visible to them immediately, but identification by name was impossible without their already practiced mode of tactual exploration.

During periods of training in visual recognition, instantaneous recognitions did not occur, but a gradual integration of separate details ultimately resulted in recognition.

Similar to Senden's compilation, a report from Voronezh Medical Institute in Russia (London, 1960) outlined the progress toward visual discrimination and recognition in postoperative cataract patients. The children were unable to recognize objects by name although they reported seeing something. If the object were familiar to them, recognition was immediate upon tactual contact. Unfamiliar objects which were viewed and touched were related to familiar objects. Form, size, bulk, number, color, and distance were all indeterminable upon sight. All processes for visual recognition were carried out more slowly than in normally seeing children, who operated by sight alone, suggesting that "visual receptors to cortical termini" had to be stimulated slowly. This account is more specific, yet similar to Senden's data, and is in harmony with Gesell's theory of visual development in the infant and young child. The physiological process of form discrimination can be accounted for by excitation of the nerves within the "primary projection system of the eye," the center of which is the fovea (Day, 1957). The reception of visual stimuli by foveal cells produces the sharpest acuity because these cells are directly connected to visual receptors in the occipital cortex.

The stimulation of visual cells in the peripheral retina may produce sufficient excitation for recognition of form characteristics. However, the strength of the visual impulse may be so weak that it limits coordinated motor activity, or, as in the case of nystagmus, there may be a lack of control of eye muscles. In either event, "cortical distribution is poor and disorganized"(Day, 1957; Gibson, 1951). This phenomenon is further illustrated by a study of electroencephalograms of children with severe visual defect (Lairy & Netchine, 1962). They found a 50% functional retardation in the reception of sensory impulses, and also a reduction in EEG alpha rhythm in the occipital area. However, this depression was not proportional to the degree of visual defect so could not be attributed solely to the anatomical structure of the eye. Several possible causes were suggested, one of which was the probable "inability of sensory impulses in the cortical-visual area to become afferent." However, Bateman (1962), whose study is discussed in the relation of visual defects to reading achievement, suggested that central processes appear to compensate, to some degree, for the lack of sensory afference.

An interesting thesis was submitted by Renshaw (1945), who suggested that as repeated visual stimuli are experienced and skill in discrimination increases, the retinal image increases in size and in sharpness; the sensory aspects of vision then tend to become subordinate to the motor functioning so that an integration of sensory and motor activities fulfill the act of visual discrimination.

The presence of physiological abnormalities in the basic structures of the eye complicate the entrance of light and/or the stimulation of the retinal area, thereby restricting the developmental maturation of reflexive processes such as fixation and fusion (Julia E. Lancaster, 1949). This notion relates to the findings of Lairy and Netchine (1962) in regard to the retarded functioning of psychomotor processes in children with structural defects.

Evidence of the specificity of either sensory or motor functions in visual behavior has yet to be clarified, but theoretical implications and experimental studies indicate a functional interrelatedness between them. The extent and nature of the relation appears to be dependent, to some degree, upon the increased stimulation of visual cells as a precursor to or a concommitant of developmental maturation.

Visual training. Orthoptic training was designed, specifically, to aid individuals in obtaining the best vision possible (despite anatomical limitations) by training in the use of certain muscles or groups of muscles (Sells & Fixott, 1957). Because the act of seeing involved a degree of muscular performance, the assumption was that exercise of supposedly weak eye muscles would increase their strength and size, and consequently enhance their functional efficiency (W. B. Lancaster, 1944).

Sells and Fixott (1957) felt that the improvement of visual functioning was accomplished through either orthoptic training or perceptual training, but acknowledged that, in some cases, both types of training might be necessary to effect the desired change in visual performance. Since no studies utilizing control and providing definitive evidence have shown that visual training affected pathologic conditions or motor anomalies, the increase in visual efficiency must be considered as a change in perceptual behavior (Hildreth, 1947; W. B. Lancaster, 1944). Therefore, the further review of the literature has been concentrated on the perceptual aspects of vision.

Psychophysiological Aspects of Vision

Visual acuity and visual efficiency. In both medical and psychological literature, semantic confusion and conflicting theories have been prevalent in the undifferentiated use of such terms as visual acuity, visual efficiency, and visual perception. Harvey (1959) presented a comprehensive review of the diverse psychological theories concerning visual acuity and visual perception. Some psychologists

(Allport, 1955; Postman, 1955; Sells & Fixott, 1957) now seem to agree that visual perception and learning are interdependent phenomena in determining the degree and nature of the visual efficiency of individuals. In the case of children with very low degrees of vision the concern should be with visual efficiency and not with visual acuity (Bier, 1960), and it is in this area that research appears to be most fruitful.

According to some ophthalmologists (Ehlers, 1953; Hildreth, 1947) visual acuity can have no one true value, but is determined by and is as variable as the mental capacity of each individual. Improvement in visual efficiency is thought to be a matter of learning (Julia E. Lancaster, 1949) which involves the development of: 1) Attention in order to bring the stimuli within visual range. 2) Awareness and recognition of visual form which involves cortical and emotional factors. 3) Response as an indication that learning is occurring. 4) Satisfaction, an emotional component, which determines the success or failure of the learning process. 5) Repetition, the means by which learning patterns are fully established. Conceivably, the degree of visual efficiency may be affected by restriction in development of any one of these phases.

Visual discrimination and visual perception. Visual discrimination and recognition are thought to develop through a progressive merging of three stages suggested as (Dickinson, 1926; Hake, 1957; Vernon, 1954): 1) Knowledge that something exists in the visual field although no contour or discrete parts of the pattern stand out. There could be a relation here to the ophthalmological description of "moving objects" used in denoting an extremely low degree of vision. 2) The emergence of the visual pattern as a "generic object" of some general category or one in which certain parts can be interpreted. The medical recording of "object perception" may be comparable to this stage. 3) The organization of separate details into known characteristics of a specific object completes the recognition process. In case of very low vision, this stage may be described as "counts fingers."

Submitting a statistical model for the visual recognition process, Binder (1955, p. 119) proposed several ingredients common to visual discrimination and visual perception, such as: 1) stimulating situations, 2) predisposition to instructions, 3) general class of potential stimuli (out of which one is chosen), 4) response of subject, 5) general class of acceptable responses (out of which one is made). Recognition is accomplished if the S responds with an appropriate name to visual stimuli, and it is at this point that a visual experience becomes meaningful. These common elements suggest considerable overlap between visual discrimination and visual perception, which must be regarded as mutually dependent phenomena in the total visual process.

Three phases of visual perception beyond the sensory excitation are considered essential to perception

1) a constructional process wherein the sensory qualities are suitably weighed and combined, each in its appropriate degree of importance, into a more or less clearly differentiated formal structure.
2) an assimilative process whereby the present percept is related to the body of past experience--compared, accepted, or rejected--and is then referred back to some part of the external environment from which it is assumed to have originated.
3) a response tendency, indicating the observer's reaction, overt and implicit, to the full implications of percept (Douglas, 1947, p. 5).

Visual perception is a "decision process which involves the utilization of discriminatory cues" (Bruner, 1957, p. 127). One of the most important aspects of perceptual learning is the ability to "code the environment in terms of its object character." The development of cues for appropriate placement of objects in categories may evolve unconsciously as visual learning advances.

Obviously, "limitation of the visual channel places a heavy load on the interpretative functions" (Hake, 1957, p. 37), and although interpretations may be accomplished with difficulty, they can be achieved. This supposition appears to place the major responsibility for explication on cerebral processes. Whether Gesell was inferring a similar idea is unclear, but he postulated possible continued growth of visual behavior patterns as a result of training and experience. In cases of sensory deficit in the visual mechanism, it is plausible that a longer duration of stimulation is necessary in order for transmissions from the retina to the brain to be effected and interpreted. Possibly, a trinary but unequal sequence of sensory, motor, and cerebral processes occurs in which superior cerebral functioning may compensate for inadequacies in either sensory or motor areas, a suggestion related to Hebb's (1949) neural theory to be discussed shortly.

Numerous experimental studies in psychology (using Ss with normal vision) either imply or lend direct support to these postulations. Exposing figures for differentiation, matching, and recognition, Freeman (1929) concluded that repetition and rapidity of exposure increased recognition ability, and that if a given configuration were similar to one previously recognized, the response was easier and faster.

The learning of form recognition was studied (Fehrer, 1935) by presenting repeated, rapid exposures of different figures. Ss showed a beginning state of insecurity in recognition, but appeared to progress consistently through the three phases of visual perception previously discussed, until recognition was rapid and accurate. Further substantiation for Hake's theory of a "heavier load on interpretative functions" may be seen from studies dealing with functional perception in the retinal periphery. Drury (1933) studied behavioral changes in adults from exposure to meaningful material. The Ss registered gains, losses, shifts, and regains, after which recognition became stabilized and certain. "The main progress was from labile, uncertain, and inconclusive function to a fixed, stable, and conclusive performance whose end-product was a determinate and abiding object" (Drury, 1933, p. 646). She concluded that it was possible for percepts to be developed fully from vague and distorted sensory patterns.

A multitude of experiments concerned with brief exposures of visual stimuli have not delineated clearly whether the effects are concerned with the visual system or cerebral interpretations. Hake (1957) theorized that without prior information or alternatives in regard to the stimulus, the need for a strong visual image was greater.

Many factors are involved in perceptual learning some of which have been summarized in a review by Sells and Fixott (1957). The amount and frequency of practice correlate positively with the sum of learned responses; evidence points to the occurrence of greater effects in the early stages of learning; feedback of correct responses by the experimenter serves as reinforcement; distribution of practice has been more effective than massed drill. No measurement of Ss motivation has been reported, but in experiments dealing with extinction and retrials to learning, periodic reinforcement with knowledge of results has tended to reestablish correct responses.

Experimental investigations of the effects of past experiences (Djang, 1937; Henle, 1942) have led to the conclusion that when several alternative courses were possible, previously experienced perceptions dominated the choices of the perceiver. Pratt (1950) suggested that past experience was negligible at the sensory level, but maximum at the motor level. At whatever level, visual stimulation accompanied by teaching of accurate perceptions of objects would appear to be a necessity for the child with severely impaired vision in order for him to build a substrata of perceptual choices. Bateman (1962, p. 110) intimated a similar idea, in a study to be discussed in the next section, when she suggested that "many partially sighted children need help in interpreting or obtaining meaning from visual symbols."

Various theories of perceptual defense pervade psychological literature, but the most widely accepted one is known as the "hypothesis theory" (Brown, 1961, p. 79) based primarily on "set" theory. The basic notion is that perceiving takes place when one is prepared for seeing by "the input and confirmation of information from the environment," and that "visual recognition response is to a considerable degree, a learned response." Conflicting reports have appeared as to the significance of the relationship between stimulus emotionality and the ease and speed of visual recognition (Rosenzweig & Postman, 1958; Forrest, 1962). Both medical and psychological theorists stress the importance of self-motivation and satisfaction in perceptual learning. Perhaps children who have depended on channels of learning other than visual are not aware that visual perception could give them a satisfying feeling. Given an opportunity to become aware of the possibilities for visual enjoyment at near point, it seems possible that many such children would develop an interest in "learning by seeing."

Sensory impairment and visual perception. Psychological experiments have been concerned primarily with sensory and perceptual phenomena in adults whose visual mechanisms were structurally intact. For this reason, no direct relationship can be assumed to exist with any children, more specifically with children who have marked physical deviations of the eye.

Hebb's psychoneurological theory of visual behavior appears to be particularly germane to the problems of visual stimulation and neural transfer which probably accompany a defective visual mechanism. His theory is based on the assumption that "a particular perception depends on the excitation of particular cells at some point in the conceptual neural system" (Hebb, 1949, p. 17). He suggests that the development of visual perception is a process involving a triumvirate of functions within the neural system--sensory, motor, and cognitive. No one of these individual systems can completely dominate either behavior or perception, but each performs an unique "mediating process" in preparation for a suitable response. The process of mediation occurs by the formation of "cell assemblies" (upon repeated stimulation of certain cells) resulting in a chain of central cortical events with motor links in perceptual cells. Provided there is no breakdown in the "phase sequence," "the same properties of form are perceived whatever the retinal projection, provided the acuity is sufficient" (Hebb, 1949, p. 49). Consequently, the more constant the visual stimulation from an object, the more spontaneous will be the identification and response.

As a theoretical supplement to his former assumptions, Hebb (1955) discussed the relation of drives to the conceptual nervous system. His definition of motivation was

> a general energizing of behavior, and especially to the sources of energy in a particular set of responses that keep them temporarily dominant over others and account for continuity and direction in behavior (Hebb, 1955, p. 244).

The neural theory of Hebb is compatible, not only with the physiological developmental theory of Gesell, but also with the findings of Lairy and Netchine in regard to alpha depressions in visually impaired Ss. Although a number of psychologists have found it contradictory to other accepted theories, actual research findings appear to verify its credibility regarding the nature of visual perception, especially in individuals with structural anomalies.

Educational Aspects of Vision

Functional behavior. Educational psychologists view the child as

> an organism capable of spontaneous development, having inherent in him not only the tendency to develop his potentialities, but also the power of using to that end, the means to be found in his environment (Fynne, 1924, p. 232).

The purpose of education then is to encourage the spontaneous behavioral development at its most incipient period, and to facilitate "a harmonious innate development."

Through the integration of sensations received from his environment during the early years, the child lays the foundations of his intelligence. Through observation, comparison, and judgment, "the child learns to organize schemata from a variety of combinations" (Montessori, 1914; Piaget, 1952). The perceptual development accrues from the interrelated stimulation and motor response to tactual, auditory, and visual senses (Montessori, 1914). The concommitant acquisition of expressive language promotes the clarification and specification of mental images.

Little research data point directly to the hypothesis that the young child advances through various stages in his conceptual development, although some evidence suggests that the child progresses from concrete to functional to abstract observations. However, it seems rather certain that there is a definite ongoing advancement in the ability to form concepts which are directly proportional to the stages of physical maturation and to the nature and extent of sensory experiences (Montessori, 1914; Piaget, 1952). If one accepts the theories of Gesell and Hake as to continued maturation and interpretative functioning, it is logical to assume that children with limited vision may progress significantly (within the limits of their visual defects and intellectual capacities) in their abilities to conceptualize from visual experiences.

Functional deficits. Lags or gaps in perceptual functioning are seldom recognized in children until they begin educational activities. Numerous theories have sought to explain children's inabilities in conceptual functioning by hypothesizing neurological abnormalities. Hinshelwood (1917) suggested that localized damage to certain brain centers required that a new center for visual memories be stimulated. Orton's (1937) theory related to confusion in visual imagery which he termed "twisted symbols." He believed the cause to be the lack of cerebral dominance in either the right or the left hemisphere of the brain. Dearborn (1933) offered an explanation of confusion in motor activity by suggesting that the reading process assumes a dominancy in the left hemisphere, and if this is lacking, the child suffers orientational disturbance. Any one of these could constitute a theoretical construct within the total neural concept of Hebb.

Reading and visual perception. The relationship of visual perceptual abilities and reading ability is based primarily on conjecture despite some attempts to establish theoretical positions which suggest researchable hypothesis. Goins (1958) made an extensive study of the relation of visual perceptual abilities and early reading progress in first grade children in public school. "Visual sensory efficiency," according to her, is a prerequisite to acquisition of skill in the perception of printed symbols. She found a wide range of perceptual abilities and various distinct "types of perceivers." Two factors of visual perception were isolated, speed of perception, and strength of closure. Little relationship was found between perceptual speed and reading progress but a strong positive correlation was noted between strength of closure and reading progress (Goins, 1958, p. 98). She concluded that the visual perceptual ability involved in word perception was a primary mental ability or aspect of intelligence which was more important at the "learning-to-read" stage than at later stages. This conclusion relates directly to Montessori's and Piaget's discussions in regard to intellectual development in children, and also pertains to Sells' and Fixott's suggestion that perceptual training resulted in improved visual efficiency.

Harris (1961) says that poor ability in visual behavior may be related to the analyzing process. The child perceives individual parts without grasping the corporate whole. The difficulty could be neurological, but he thinks the probable explanation is that the child has not learned to pay attention to details. Because reading readiness is generally underdeveloped, the child's attitude is unanalytical and uncritical. He has difficulty in the selection of similar elements from among a group of different objects or in finding the important differences among objects similar in nature (Smith & Dechant, 1961). The child who brings the most to the printed page will get the most from his reading. The degree and accuracy of the perceptions will be dependent upon the number and variety of the child's experiences, both concrete and vicarious. Logically, children who suffer from lack of sensory or perceptual stimulation require a concentrated and lengthy period of readiness development before the introduction of reading as such. In the case of children with severely restricted vision, the need for individually planned readiness training may be even greater.

Visual defects and reading. The literature is replete with studies which pertain to the relevancy of mild visual defects to reading skill, but findings provide inconclusive evidence of any significant "cause and effect" relationship (Edson, Bond, & Cook, 1953; Farris, 1936; Fendrick, 1935; Robinson, 1946). Some definitive evidence indicates that visual problems, such as severe muscular imbalance and fusion difficulties, are more likely to affect reading efficiency than do other defects (Eames, 1948, 1959; Park & Burri, 1943; Robinson & Huelsman, 1953). A justifiable conclusion appears to be that an eye defect alone need not reduce reading efficiency to a marked degree, yet any one of several defects combined with other causes may reduce reading ability (Smith & Dechant, 1961). Furthermore, it is possible that reading performance will be affected only when the severity of certain defects reaches or exceeds critical points. Bateman (1962) found that reading achievement in partially seeing students with severe visual defects was comparable to that of normally seeing children at the same grade level.

Visual handicaps and visual efficiency. A recent conference on research related to the education of visually handicapped children identified nine areas of major concern for educators working with such children. The problem of training and/or learning to see was rated as number one, and highest priority was given to "testing the hypothesis that children with all degrees of residual vision can achieve greater visual efficiency" (U. S. Dept. H. E. W., 1961, p. 5). Notwithstanding the fact that eye specialists and educators alike have accentuated the need for personal attention to children with very low vision, no experimental studies designed to evaluate their visual behavior have been reported. The dearth of educational research regarding the effects of visual impairment reveals a serious problem to all those concerned. Some suggestions and a few reported findings may be considered applicable to the multiplicity of concerns which confront visually impaired children and their teachers. Both eye specialists and educators (Dorman, 1949; Esbin, 1957; Fonda, 1956; Lowenfeld, 1955) suggest that diagnostic findings and the degree of visual acuity reveal little about the individual which can be the true determinants of a child's ability to improve his visual functioning.

Bateman (1962) delineated some of the behavioral characteristics of visually impaired children in a recent research study. She made an extensive investigation of the relation of the reading achievement and psycholinguistic abilities of more than 90% of the children in classes for partially seeing in the first four grades in Illinois (excluding

Chicago). About 20% of her sample had severe visual defects (visual acuity less than 20/200), but had significantly higher intelligence test scores than the children with mild or moderate defects. As a group, the children showed significant deficiencies on visual decoding, motor encoding, and visual motor association subtests of the Illinois Test of Psycholinguistic Abilities. The most severely visually impaired group contributed the major portion of these deficits.

An interesting aspect of the study was the utilization of standard reading tests without enlargement of print, or extension of testing time; yet the group as a whole manifested no important differences from normally seeing children in reading achievement. No existing relationship was found between the degree of visual defect and the reading achievement of the group. Even children with severe visual problems achieved at a level comparable to their grade placement. Results suggested that many of the children required help in "interpreting or obtaining meaning from visual symbols," but that "minimal sensory intake may be sufficient for near maximal central efficiency." The Bateman study offered valuable insights which could be related to neuropsychological theories in regard to visual perception:

> Even though the end organ may be defective and limit grossly the sensations received centrally, the central processes can perhaps "step-up" the magnitude of stimulation or clarity of perception (Bateman, 1962, p. 114).

Jones (1961) made a careful analysis of the reported degree of vision in relation to the reading media of all legally blind students registered for materials with the American Printing House for the Blind. Trends reflected by some of the findings suggested that differences in visual functioning could be related to developmental, physical, psychological, or environmental factors. He emphasized the need for experimental studies designed to isolate certain of the suspected variables. Ashcroft, (1963a) interpreted, in much greater detail, some of the educational implications of this study.

The only other studies of an educational nature (which used only children with known visual impairment) have dealt with typographic characteristics of materials suitable for partially seeing children. Greater numbers of children were reported able to read 24 point type than could read smaller type sizes (Eakin, Pratt & McFarland, 1961). However, style and size of type made no significant difference in the speed and accuracy of reading providing the type was of sufficient size (Eakin, _et_. _al_., 1961; Nolan, 1959). Prince (1959) explored a process of photographic printing designed to control size, interletter, and interline spacing in various type styles. Superior type face plus wider spacing was chosen by all Ss with low visual acuity as most desirable for ease in reading.

Summary

The review of research and literature presented here has sampled briefly, the developmental, psychological, and educational literature related to visual functioning. The theoretical and empirical conclusions most relevant to the present investigation are:

1. The development of the visual process apparently follows a sequential pattern; however the need for stimulation and training is evident if maximum visual efficiency is to be acquired.

2. Physiological abnormalities may restrict the activation of sensory processes and impede the maturation of visual functioning. Nevertheless, the literature suggests that increased skill in the muscular actions of fixation and fusion, plus the acquisition of interpretative cues for perceptual organization will promote continued development.

3. Visual recognition involves progressive skill in discrimination, cognitive interpretation, and subsequent conceptual integration of environmental stimuli.

4. Theories regarding the significance of psychological and neurological abnormalities for visual behavior far

exceed any clear supportive experimental evidence at this time.

5. Reported research findings of the relation of visual defects to reading ability in normally seeing or visually impaired children lack consistency in evidence, and clarity in designation of appropriate techniques of remediation. Confusion exists as to: whether distributed or massed practice is more effective; the kind and type of reinforcement for motivation; and the degree of development necessary for acquisition of greater visual efficiency.

6. Educators and eye specialists suggest that individual functioning (rather than clinical diagnostic findings or degree of visual acuity) are the true determinants of ability to improve visual functioning. However, studies relating to the behavioral functioning of children with remaining vision are unreported in the literature.

7. No instruments or procedure are known for the appraisal of visual functioning of blind children with remaining vision. There is need for a technique designed especially to measure the present visual functioning and the potential future visual behavior of these children for educational purposes.

8. The need is acute for experimental investigation of the relevance of visual stimulation programs. A recent conference on research related to the education of visually

impaired children gave highest priority to testing the hypothesis that children with all degrees of remaining vision could enhance their visual efficiency.

9. A controlled teaching experiment using pairs of Ss matched on present visual and cognitive abilities appeared to be a logical approach to a study of the effects of visual stimulation on performance.

10. The development of hypotheses for this study should be based on the theory that the group of experimental Ss receiving visual stimulation would be able to approach the level of visual efficiency demonstrated by Ss who had been using their remaining vision for educational activities.

11. Any program being researched should have as an integral part the complete outlined series of experiences the children would receive. Specific plans and techniques designed to change visual functioning and/or efficiency of blind children with remaining vision have not been published previously.

Hypotheses

The hypotheses to be tested were:

Major hypothesis I. That a short period of experimental teaching would enhance the visual behavior of blind children with remaining vision to the extent that there would be a significant increase in Visual Discrimination Test scores.

Subhypothesis Ia. That there would be a significant difference between experimental and control group mean gain scores on The Visual Discrimination Test.

Subhypothesis Ib. That there would be a significant difference between experimental and print comparison (criterion) group mean gain scores on The Visual Discrimination Test.

Major hypothesis II. That there would be a significant increase in recorded near vision acuity of experimental Ss as determined by an ophthalmologist.

Subhypothesis IIa. That there would be a significant difference between experimental and control group post-experiment recordings of near vision acuity.

Subhypothesis IIb. That there would be a significant difference between experimental and print comparison (criterion) group postexperiment recordings of near vision acuity.

METHOD

Subjects

The subjects of this experiment consisted of ten matched pairs of blind children with remaining vision. They were matched on their abilities to make visual discriminations of reading readiness items as measured by pre-experiment test scores on The Visual Discrimination Test.

Children included in this investigation met the following criteria: (a) had reached their sixth birthday, but had not passed their thirteenth birthday, (b) had within the last two years received an individual Interim-Hayes-Binet Intelligence Test score of 80 or above, (c) had attended a residential school for the blind from first grade to their present grade placement, (d) had received no planned classroom instruction with visual materials, (e) had an ophthalmological distance acuity measurement not less than object perception nor greater than 6/200 in either eye, resulting from conditions present from birth, and with a prognosis of no improvement, and (f) were free of any known impairments other than visual, which might present additional learning problems.

For this experiment, it was necessary for the investigator to administer to the selected low vision children a continuous program of visual stimulation as a part of their regular school day.* A matched control group of Ss was considered essential to the control of the experiment.**

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*The investigator is indebted to the administration, teachers, and selected children at the Tennessee School for the Blind who made it possible for this special project to be completed at that school.

**The Illinois Braille and Sight Saving School kindly volunteered children for selection of a control group.

Eleven children at the Tennessee School for the Blind met the prerequisites for inclusion in the study as experimental Ss, and fifteen children from the Illinois Braille and Sight Saving School met the conditions stipulated for control Ss. By matching solely on visual discrimination pretest scores, it was possible to match eleven pairs initially. All eleven children were included originally in the experimental group in case any subject should be unable to continue, which in fact, did occur in a very short time.* Ten matched pairs comprised the total sample to be discussed except for a reference to the eleventh pair in the discussion of supplementary findings. The selected pairs had scores which differed by as little as one point, and by no more than five points on pretest scores as is shown in Table 1.

The scores in both groups were comparably distributed and similarly variable. The experimental group scores ranged from a low of 17.5 to a high of 53 (highest possible score 58); the mean was 36.45 with a standard deviation of 12.77. The range of scores in the control group was from 13 to 54, with a mean of 36.2, and a standard deviation of 9.635.

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*Information regarding this S will be included in the discussion section.

Table 1

Comparison of Experimental and Control Groups on Visual Discrimination Scores

(Beginning of Study)

Pair Number	Visual Discrimination Test Scores Experimental	Control
1	53.0	54.0
2	53.0	51.0
3	48.0	47.0
4	40.5	44.0
5	39.0	41.0
6	37.0	41.0
7	30.5	27.0
8	25.0	27.0
9	21.0	17.0
10	17.5	13.0
Means	36.45	36.30
Standard Deviations	12.77	9.635
t	.808	
F	1.32	

t (.975/df, 9) = 2.23

F (.975/df, 9) = 4.03

The mean difference in experimental and control group matching scores was analyzed for significance by use of the t test for matched pairs. A t value of .808 and an F ratio of 1.32 indicated the preciseness of matching and the similar variability of the pairs on the critical variable of the ability to make visual discriminations of reading readiness items.

Chronological age, mental age, and grade level were considered also as important variables, and although it was impossible to match individual pairs on these variables, little difference in group means was evident (see Table 2).

Table 2

Comparison of Experimental and Control Groups on Important Variables (Beginning of Study)

	Important Variables					
	Chronological Age in Months		Mental Age in Months		Grade Level	
	Experimental	Control	Experimental	Control	Experimental	Control
Means	120.7	128.4	115.3	119.5	2.8	3.0
Standard Deviations	19.4	20.25	24.0	25.3	-	-

The mean chronological age for the experimental group was 120.7 months with a standard deviation of 19.4 months, and the chronological age mean for the control group was 128.4 months with a standard deviation of 20.25 months. The experimental group had a mean mental age of 115.3 months with a standard deviation of 24.0 months, and the mental age mean for the control group was 119.4 months with a standard deviation of 25.3 months. The grade level mean was 2.8 for the experimental group and 3.0 for the control group.

Inasmuch as two of the matched pairs obtained pretest scores which indicated some elemental ability in discrimination and recognition of words and phrases (in large typewriter type), the Word Recognition and Sentence Reading sections of the Gates Primary Reading Tests, Form 1, (Gates, 1958) were administered to the experimental Ss at the time of pretesting. The test was presented in regular size type, and with no deviation from the designated time limits suggested for normally seeing children. It was possible to obtain similar measures on the control Ss only near the close of the experiment.

The two experimental Ss scored 2.35 and 1.8 respectively on the Word Recognition section of the Gates, and one S was able to read some sentences so that he scored at a 2.17 grade equivalent on the Sentence Reading section. Obviously, these Ss had had sufficient curiosity and self-motivation to cause them to make some use of their remaining vision without the advantage of conventional instruction with visual materials. Teachers of both children reported that previous to this study they enjoyed looking at print materials, and made inquiries about certain letters and words, although no effort had been made to teach them visual symbols in the classroom.

As a basis for comparison of visual functioning of some blind children with remaining vision, and in order to have an approximation of possible expected visual behavior of experimental Ss, a third group was included for study. This group was designated as the print comparison or criterion group. Ten children, seven males and three females, were selected on the same criteria as the other children with these exceptions: (a) had distance acuity measurements ranging from object perception to 20/200 in the better eye after correction, (b) were in grades one through four (there were no eligible children in the fifth grade), and (c) had received educational instruction exclusively with visual materials.

The mean score for the print comparison group on The Visual Discrimination Test was 49.64 with a standard deviation of 11.51. The mean chronological age was 111.0 months with a standard deviation of 18.77, and similarly, the mental age mean was 110.0 months with a standard deviation of 19.12.

In order to obtain a measure of the reading ability of the print comparison group, the Paragraph Reading section of the Gates Primary Reading Test, Form 1 (Gates, 1958) was administered without enlargement of print or extension of time. The grade level scores ranged from 1.5 to 4.1 with a mean grade level of 2.62.

An ophthalmologist recorded the near vision acuity of experimental Ss previous to, and upon the completion of the experiment by use of the Guibor Near Vision Chart.

The chart was designed to give measurements of near acuity which are comparable to the Snellen E distance acuities, and to describe the relative percentage of visual efficiency. Those Ss for whom no measure of near acuity could be recorded were given a Snellen distance equivalent of 1/200 if they could distinguish moving objects or count fingers at one foot.

The highest degree of near acuity recorded for any S in this group previous to the experiment was 6/140, and although two Ss had residual vision in each eye, the ophthalmologist reported that neither child was able to use his vision binocularly so that the acuity was not increased by the retention of vision in each eye.

Conditions beyond the control of the investigator prevented a recording of near acuity of control Ss previous to the experiment; however, a measure was obtained near the completion of the experiment, and is reported in the discussion of data results.

The ophthalmologist previously mentioned recorded near vision acuities for Ss in the print comparison group previous to and upon completion of the experiment, and these ranged from 2/140 in only one eye to a maximum of 14/47 in both eyes. One-half the Ss had more useful near vision in both eyes than in either eye alone.

All pretesting and posttesting of Ss was completed by two qualified educational testers. Each examiner had a background of teaching experience with visually impaired children, and was enrolled at the time as a graduate student in the Department of Special Education at George Peabody College for Teachers of Nashville, Tennessee. After pretesting, all tests were deposited with the investigator's major advisor, and only the total scores were reported to the investigator for purposes of matching. At the conclusion of the teaching experiment, each examiner was given a list of the children she had pretested so that each child was tested by the same examiner at both testing periods, and all posttesting of experimental Ss was completed within two days of the last scheduled visual stimulation session. At the conclusion of the posttesting, all data were given to the investigator for the final analysis.

Instrument

The Visual Discrimination Test was used to measure the effects of the experimental visual stimulation program on the visual behavioral changes of children in all groups.

Two scores were obtained to determine the mean difference in gain for experimental Ss, the mean difference in gain for matched pairs, and the mean difference in gain between the control and criterion groups.

The instrument was designed specifically for this study by the investigator since no suitable standardized instrument was available. The test purports to measure the S's ability to discriminate and recognize readiness items which had been appropriately adapted and enlarged for children with low degrees of remaining vision.

Based on Hebb's (1949; 1955) neuropsychological theory of visual perception, and Montessori's (1914) developmental learning theory, the test items were selected, developed, and arranged in four sequential stages for discrimination and recognition of (see Appendix A):

1. Geometric forms related in size and contour presented in solid black
2. Single objects of one class presented in
    a. Solid black form
    b. Outline shapes
    c. Pictures with few inner details
3. Objects of a variety of classes presented in
    a. Single pictures with full inner details
    b. Grouped pictures

4. Words and letters presented
    a. Singly
        (1) Of different configuration
        (2) Of similar configuration
    b. In groups
        (1) Of unlike configuration
        (2) Of like configuration
        (3) As phrases
        (4) As simple sentences

Items were selected which were in keeping with a progression of discrimination and recognition techniques to be taught according to the following sequence (see Appendix A for greater detail):

1. Noting likenesses and differences
    a. In classification
    b. In size and/or position
    c. In inner details
2. Matching of forms and objects in
    a. Same class
    b. Different class and different contour
    c. Different class and same contour
3. Ordering in progressive sizes
4. Relating objects as to
    a. Class
    b. Use
    c. Similarity to other objects

5. Discriminating missing parts of objects, pictures, and symbols
    a. With total visible
    b. Without total visible
6. Integrating parts of objects, pictures, and symbols
    a. With total visible
    b. Without total visible
7. Recognizing and identifying objects and symbols as to
    a. Class
    b. Use or function
    c. Name

The items increased gradually in detail as they diminished from one and one-half inches to a quarter inch in size including large type size of a Smith-Corona portable electric typewriter, Model No. 200 which had sans serif type spaced at six letters per inch.

A pool of 105 preliminary test items was administered to 30 blind children with remaining vision whose characteristics were similar to those in the experimental sample, and to a comparable number of normally seeing kindergarten children. An item analysis was made according to the procedure outlined by Ross and Stanley (1954), and 49 items which demonstrated the best degree of discrimination were selected for the final test (see Appendix C for raw data on item analysis).

The instrument was divided into three subtests, in which the items progressed in difficulty level as they decreased in size. The subtests were arranged so as to measure progressive abilities in discrimination and recognition.

Validity (or the extent to which the test measured the level of developmental visual functioning) for The Visual Discrimination Test was based primarily on rational evidence of content related to a developmental concept of visual discrimination.

Content validity was built into this test by the selection of items which became increasingly difficult to discriminate and recognize visually by virtue of diminishing size and increasing complexity. The pilot study and pretest data substantiated the realization of this intent by showing a consistently decreasing proportion of correct responses in each successive subtest by both low vision children and by normally seeing kindergarten children.

The concept or construct validity of the test is based on the theoretical grounds that visual functioning or visual efficiency is a developmental skill which can be measured. Satisfactory evidence of this validity rests on the homogeneity of scores of the criterion or print comparison group (who had higher degrees of visual acuity, and who were already demonstrating visual discrimination and recognition abilities) in contrast to the heterogeneity of scores in the experimental sample whose level of visual functioning had not been examined previously.

Evidence of item validity was available from an item analysis (Ross & Stanley, 1954) of the original 105 items presented to both the blind children with remaining vision, and to the normally seeing kindergarten children. The final 49 items which gave indication of acceptable discrimination value (according to the formula suggested by Ross & Stanley, 1954) were supplemented by nine new items in order to raise the ceiling or difficulty level of the test.

The close agreement of pretest scores of all individuals with their clinical recordings of visual acuity provided some evidence of concurrent validity. The print comparison or criterion groups scores were higher than those of the experimental sample which had much lower degrees of recorded acuity. Further evidence of concurrent validity was suggested by the teacher's judgments of visual efficiency by demonstrated visual performance in the use of print reading materials.

The Visual Discrimination Test appeared to have excellent face validity according to the testers, who reported that the children found it interesting and attractive. Many children noted the requirement of increasing visual discrimination and recognition, and some refused (on pretesting) to attempt the items with letter and word symbols, remarking that they did not know print letters, or that they couldn't see the print. Although this behavior was repeated by some control Ss, only one S in the experimental group omitted any of the printed symbols on the final testing.

Very satisfactory reliability of The Visual Discrimination Test was demonstrated by the analysis of initial test and retest scores of the experimental sample (see Appendix C). An internal consistency reliability coefficient of .96 was computed by use of the procedure developed by Kuder and Richardson (Ross & Stanley, 1954). The strength of this coefficient indicated that individual test items differentiated between high and low scorers in much the same manner as did the total test scores.

A split-half (odd-even) reliability coefficient of .97 (computed on initial scores of the experimental sample) corrected by the Spearman-Brown formula, indicated that the items were comparable in progressive difficulty throughout the test.

Further evidence of reliability was available from a retest stability coefficient derived from an analysis of the final test scores of the control and criterion groups (Appendix C). This coefficient of .98 showed that Ss acquired very similar scores at both testing periods, and suggests a strong possibility of very little change on successive administrations of this test.

Procedure

All lessons were conducted by the investigator, who worked individually with two children at a time during the morning of the school day. Time assignments were varied to prevent any individual from being permanently assigned to a more or less desirable time of day. The time devoted to visual activities gradually increased from a period of 20 minutes at a time to the full session of 45 minutes by the end of the second week, although rest periods were arranged to prevent the possibility of fatigue in any child.

Except for the week of spring vacation at the school, the majority of children met with the investigator for 45 minutes daily from March 13 through May 22, 1963, and received approximately 30 hours of teaching designed to increase the functional use of remaining vision. One boy was ill for two weeks, which reduced to approximately 22 hours his instructional sessions.

The lessons were planned to be a stimulating and enriching approach to the development and improvement of functional use of low degrees of vision. Since the investigator had no knowledge of pretest performance except the Ss's scores, individual lessons began at the same level for all Ss. The rate of presentation, however, varied according to the aptitude and daily progress of each individual which was evaluated by scores on a rating chart (see Appendix B). The chart was checked daily, and observational data on each S was recorded, and will be referred to in the discussion section. A summary of the qualitative data on each child appears in detail in Appendix B. When necessary, the previous lesson was reviewed or was presented a second or third time before new material was introduced.

Every effort was made to provide interesting and appropriate readiness and primary materials which were carefully selected for their high visual appeal to children with limited degrees of vision. (A listing of all materials and equipment utilized in this experiment may be found in Appendix A).

Reinforcement was offered the children by praise of their individual successes, by encouragement in their efforts to relate discriminations to previous materials or known objects, and by calling attention to the increasing development of visual recognition skills.

Specific procedures were included in the daily presentation to evoke the maximum degree of proficiency in

1. Attention to and meaningful interpretation of verbal instructions

2. Communicative exchange regarding visual discriminations as to size, shape and diversity, and relation to known objects or class categories
3. Recognition of particular identifying characteristics of visual stimuli
4. Participation in games and puzzles requiring discrimination and recognition of individual parts

No attempt was made to present separate activities exclusively for the enhancement of physical, psychological, or educational aspects of visual efficiency; rather, the interrelatedness of all aspects of visual stimulation was accentuated. Each lesson was carefully planned to provide the degree of flexibility essential to individual adaptation and minor additions or deletions were made as they became necessary. These changes were noted on the daily lesson plan, and incorporated in the final compilation of lesson plans included in Appendix A. The rapid rate of progress of a few children resulted in their completion of the planned sequence of 40 lessons prior to the close of the experiment. For them, reading material appropriate in type-size and reading level was provided, and plans for each child were made daily on an individual basis.

During the teaching period, it was observed that children who possessed vision in each eye appeared to use only one eye at a time at very near point, and others had sight in only one eye. The Harris Test of Lateral Dominance was administered to all experimental Ss in an attempt to determine the existence of a relationship between the dominance pattern and the rate or extent of progress in visual functioning.

RESULTS

Analysis of Data

The criterion for the statistical analysis of the effects of the experimental teaching was the .05 level of significance throughout. However, higher levels of significance were reported as they were observed. An analysis of variance (made by computer) was utilized to determine the overall effects of the treatment on the test scores for all groups. The total analysis, shown in Table 3, was derived by two measures of one variable for three subject groups of ten each. An F-ratio of 4.237 (F/.95, df 2/27=3.33) indicated a significant variation between the groups on pretest and posttest scores. The variability among individuals within the groups from one testing period to the other was highly significant as is indicated by an F-ratio of 20.887 (F/.99, df 1/27=7.68) greater than the .01 probability level of occurrence. The interaction of the treatment variable within individuals in groups yielded an F-ratio of 8.682 (F/.99, df 2/27=5.49) beyond the .01 level of significance,

Table 3

Analysis of Variance of Pretest and Posttest Scores of All Subjects on Visual Discrimination Test

Subject Number	Experimental		Control		Criterion	
	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
01	53.0	56.0	54.0	54.5	56.5	57.5
02	53.0	57.5	51.0	44.0	56.0	55.5
03	48.0	56.0	47.0	51.0	54.5	57.0
04	40.5	53.5	44.0	48.5	54.0	54.5
05	39.0	44.5	42.0	48.5	53.0	55.0
06	37.0	52.0	41.0	46.5	51.5	55.0
07	30.5	43.0	27.0	24.5	51.0	55.0
08	25.0	24.0	27.0	19.0	44.0	51.0
09	21.0	42.5	17.0	13.0	43.0	48.5
10	17.5	36.0	13.0	17.0	33.0	38.0

Source	Mean Square	df	F-ratio	F/.95	Probability
Between-Subjects	332.578	29			
B (Between Groups	1117.267	2	4.237	3.33	.05
Error between	263.713	27			
Within-Subjects	31.396	30			
A (Pretest and Posttest)	301.504	1	20.887	7.68	.01
AB (interaction)	125.317	2	8.682	5.49	.01
Error within	14.425	27			
Total	174.519	59			

and indicated that the interaction was not the same for separate groups as can be observed in Figure 1 which plots the slope of the lines indicating the change in means for all groups between testing periods.

The significant interaction shown by the analysis of variance validated the use of appropriate _t_ tests for determining the significance of the differences within individuals and among the groups as hypothesized.

Major Hypothesis I. That a short period of experimental teaching would enhance the visual behavior of blind children with remaining vision to the extent that there would be a significant increase in individual Visual Discrimination Test scores.

The _t_ test for related measures (Formula 7.10, Walker & Lev, 1953, p. 152) was used to test this hypothesis. Changes in individual test scores of Ss in the experimental group are shown in Table 4. Scores on the pretest ranged from 17.0 to 53.0 of a possible 58 points with an average of 36.45. Posttest scores ranged from 24.0 to 57.5 with an average of 46.5. The group became more homogeneous in its visual functioning as those children whose near vision had been unstimulated acquired amazing functional vision by the teaching procedure. A mean gain in difference scores of 10.05 with a _t_ value of 4.41 indicated that, between the two

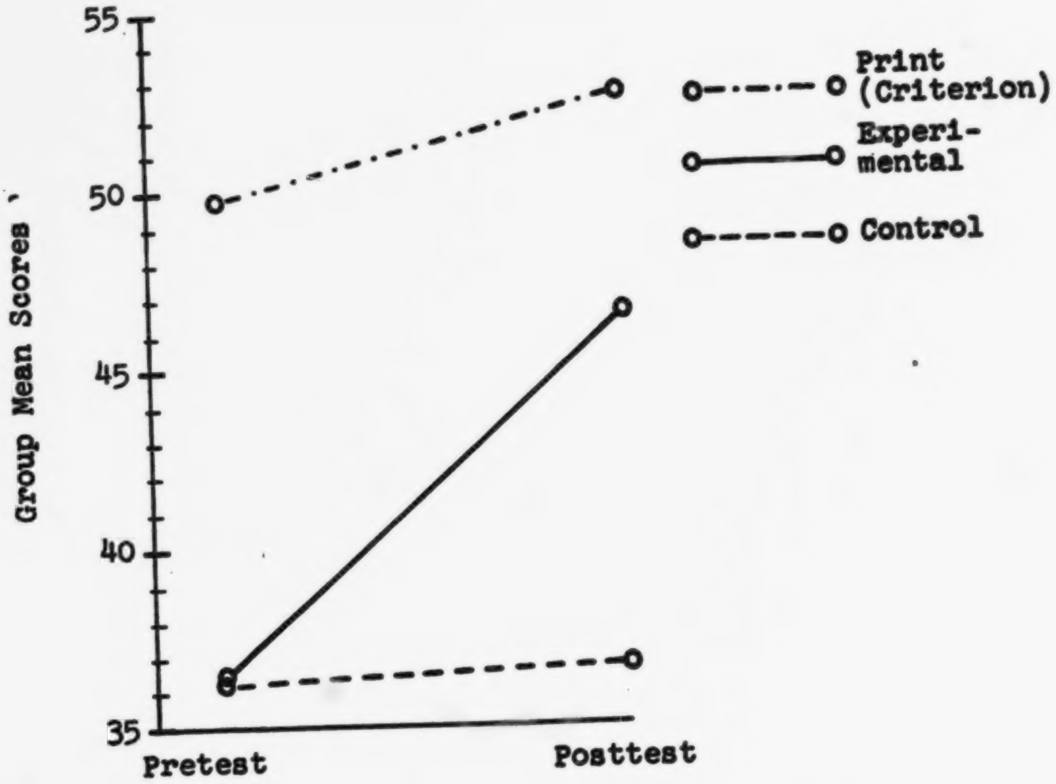

Figure 1. Differences in mean group changes on pretest and posttest comparisons of Visual Discrimination Test scores.

testing periods, a highly significant difference developed in the experimental Ss.

Table 4

Differences in Visual Discrimination Test Scores of Experimental Ss as found by Pretest and Posttest Comparisons

Subject Number	Visual Discrimination Test Scores		
	Pretest	Posttest	Difference
01	53.0	56.0	3.0
02	53.0	57.5	4.5
03	48.0	56.0	8.0
04	40.5	53.5	13.0
05	39.0	44.5	5.5
06	37.0	52.0	15.0
07	30.5	43.0	12.5
08	25.0	24.0	-1
09	21.0	42.5	21.5
10	17.5	36.0	18.5
Means	36.45	46.50	10.1
Standard Deviations	12.77	10.70	2.29
t		4.41 ($p<.005$)	

t (.95/df, 9) = 1.83

Figure 2 shows that substantial gains resulted in all Ss in the experimental group with the exception of one who was absent for the last two weeks of the eight week experiment. These data confirm the first major hypothesis that a

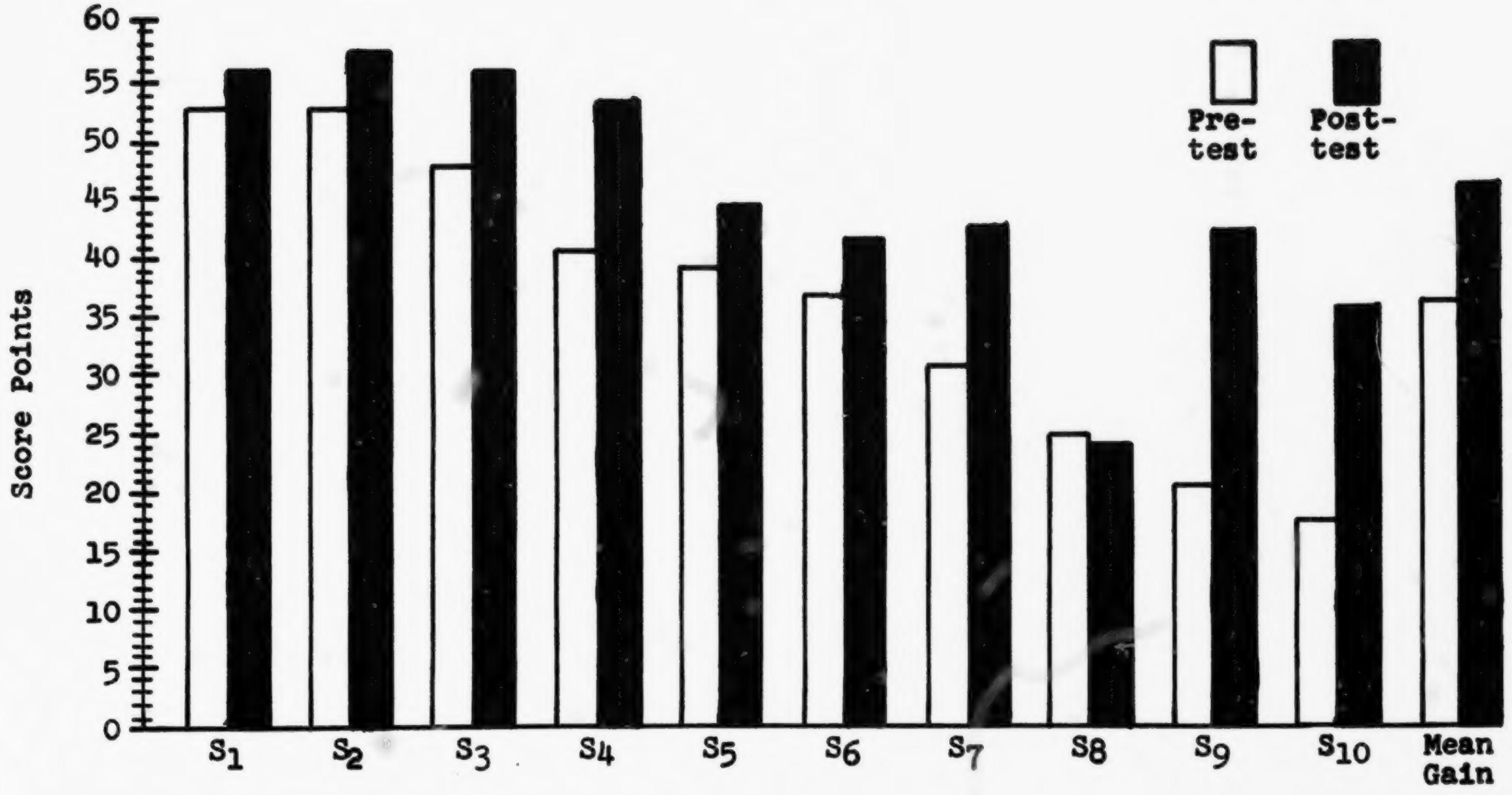

Figure 2. Gains in experimental subjects on pretest and posttest scores of the Visual Discrimination Test.

teaching program designed for visual stimulation would significantly enhance the Visual Discrimination Test scores of blind children having remaining vision.

Subhypothesis Ia. That there would be a significant difference between experimental and control group mean gain scores on The Visual Discrimination Test.

The difference in experimental and control group mean gain over the treatment period was analyzed for significance by use of the t test for matched pairs (Formula 7.10, Walker & Lev, 1953, p. 152). As can be seen from Table 5, the t value of 2.78 ($p < .05$) indicated that highly significant differences existed between the mean gain scores of experimental and control subjects at the conclusion of this experiment thereby confirming subhypothesis Ia.

Eight of the ten children in the experimental group achieved test score gains greater than their matched controls. These differences may be observed in Figure 3. The maximum gain for any control S was 7.5 score points, whereas four Ss failed to achieve their pretest scores by losses of 2.5 to 8.0 score points. All experimental Ss who received lessons in visual stimulation increased their scores from 3.0 to 21.5 points with the exception of one boy whose score decreased by one point.

Figure 4a depicts the close relation and almost identical means of the two groups at pretesting. Figure 4b portrays the wide differences between the groups and the significant increase in the mean score of the experimental group whereas the control group mean remained virtually the same.

Table 5

Differences in Visual Discrimination Test Score Gains for Matched Pairs as Found by Pretest and Posttest Comparisons

Pair Number	Experimental Gain	Control Gain	Difference in Gain for Matched Pairs
01	3.0	0.5	2.5
02	4.5	-7.0	11.5
03	8.0	4.0	4.0
04	13.0	4.5	8.5
05	5.5	7.5	-2.0
06	15.0	5.5	9.5
07	12.5	-2.5	15.0
08	-1.0	-8.0	-7.0
09	21.5	-4.0	25.0
10	18.5	4.0	14.5
Mean Gain			8.2
Standard Deviation of Gain			2.95
$t = 2.78$ ($p < .05$)			

t (.95/df, 9) = 2.26

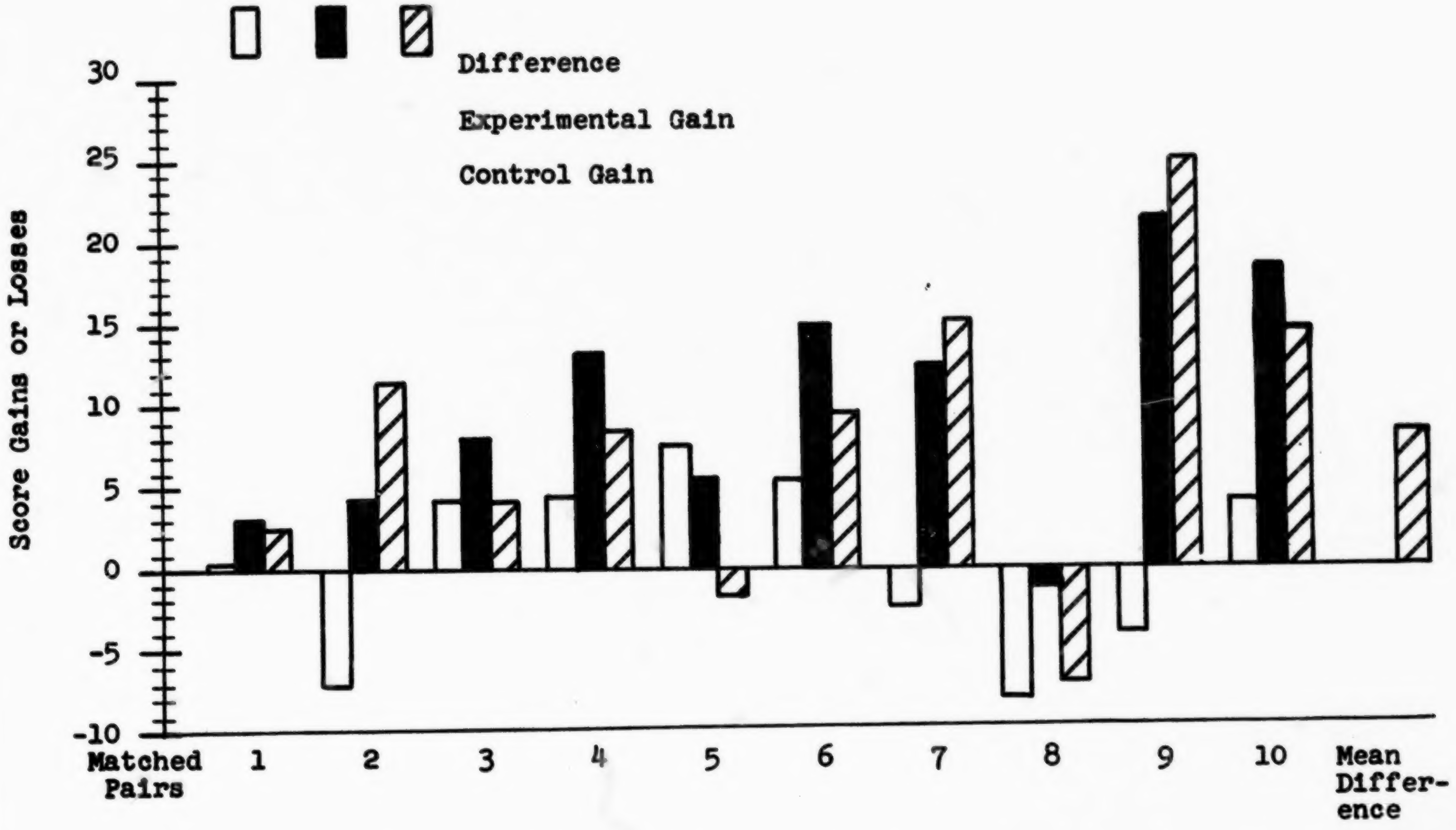

Figure 3. Difference in gains of matched pairs on pretest and posttest scores of the Visual Discrimination Test.

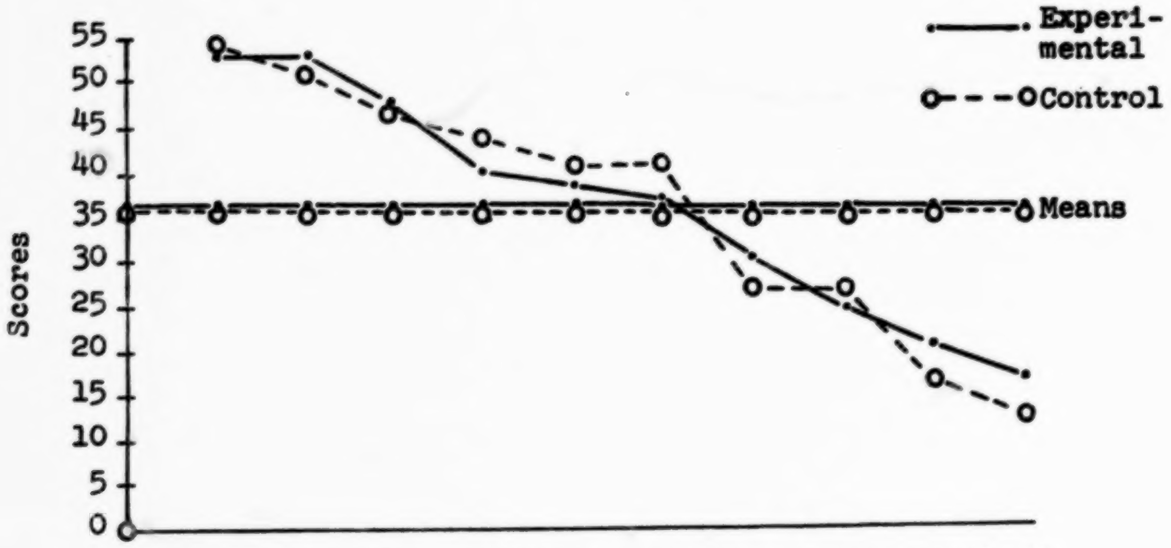

Figure 4a. Comparison of matched pairs on pretest scores on the Visual Discrimination Test.

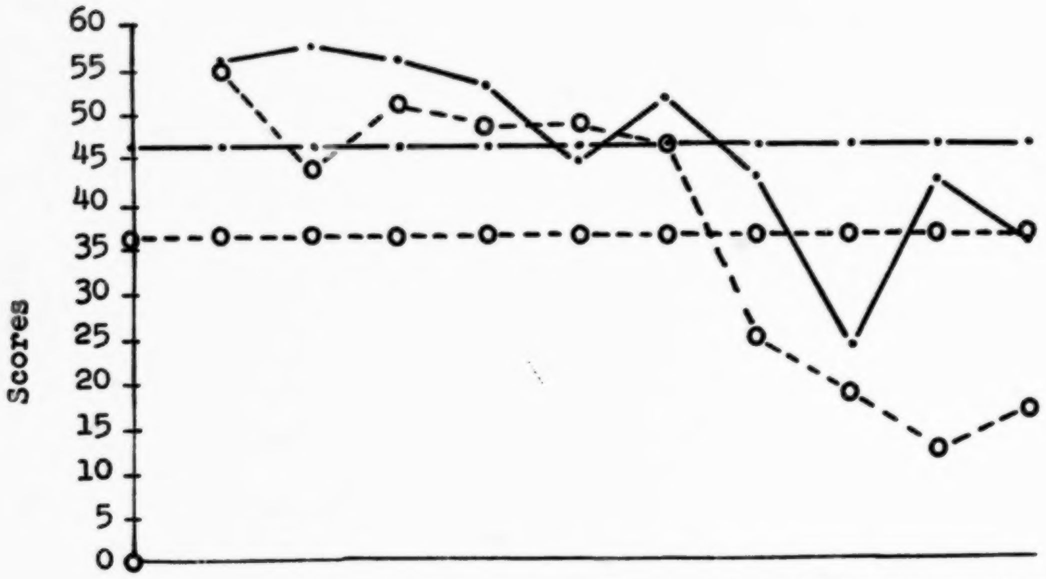

Figure 4b. Comparison of experimental and control matched pairs posttest scores on the Visual Discrimination Test.

Subhypothesis Ib. That there would be a significant difference between experimental and print comparison group mean gain scores on The Visual Discrimination Test.

Since the print comparison group was denoted as a criterion group which possessed different visual characteristics, the t test for unrelated measures (Formula 7.23, Walker & Lev, 1953, p. 156) was utilized to test the significance of the difference in mean gain scores between the two groups.

An examination of Table 6 reveals a t of 2.90 ($p < .05$), and indicates that a strong difference existed in the mean gain scores of the experimental group as compared to the print comparison (criterion) group, and confirmed subhypothesis Ib.

Figure 5 clearly depicts that the majority of experimental Ss acquired score gains in excess of the maximum gain of any individual in the print comparison (criterion) group.

Major Hypothesis II. That there would be a significant increase in recorded near vision acuity of experimental Ss as determined by an ophthalmologist.

Because of the fact that near vision acuity recordings did not yield quantitative measures, the nonparametric signs test for related measures (Siegel, 1956) was most appropriate for testing this second major hypothesis and the subhypotheses IIa.

Table 6

Differences in Visual Discrimination Test Mean Gain Scores for Experimental and Print Comparison Groups as Found by Pretest and Posttest Comparisons

Subject Number	Visual Discrimination Test Score Gains Experimental Gain	 Print Comparison Gain
01	3.0	1.0
02	4.5	-0.5
03	8.0	2.5
04	13.0	0.5
05	5.5	2.0
06	15.0	3.5
07	12.5	4.0
08	-1.0	7.0
09	21.5	5.5
10	18.5	5.0
Mean Gains	10.05	3.5
Standard Deviation	2.41	
t	2.90 ($p < .05$)	

t (.95/df, 9) = 2.26

As can be seen from an observation of Table 7, a positive sign was recorded (in cases of an improvement in the near vision acuity recording) for seven of the ten Ss. The negative signs for two individuals were indicative of a decrease in measured near vision, but no sign was recorded for the S who demonstrated no change in acuity measurement.

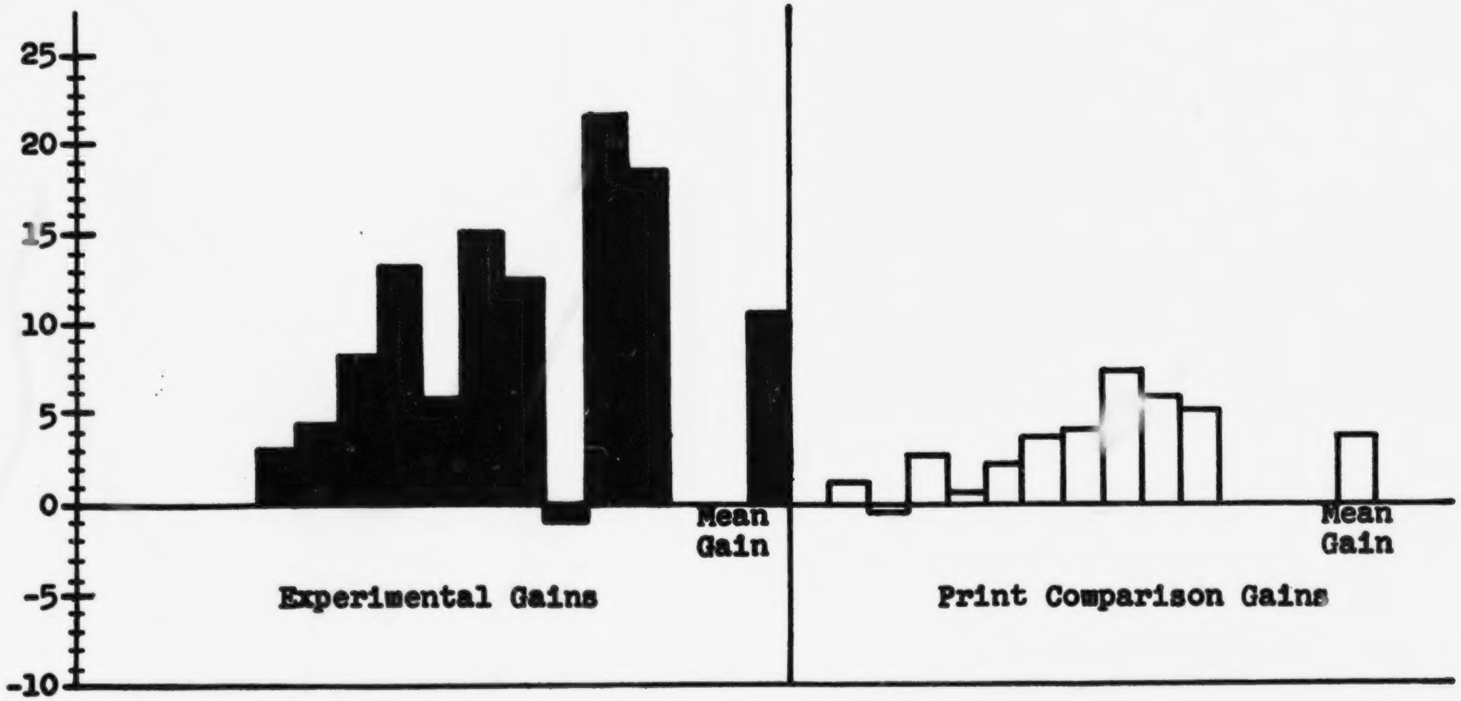

Figure 5. Differences in gains between experimental and print comparison (criterion) groups by comparison of pretest and posttest scores on the Visual Discrimination Test.

Table 7

Recordings of Differences in Near Acuity of Experimental Ss by Pretest and Posttest Comparisons

Subject	Pretest Near Acuity OD = Right Eye OS = Left Eye	Posttest Near Acuity	Po = Posttest Pre = Pretest	Sign
01	OD -- OS 4/140	OD -- OS 5/140	Po Pre	+
02	OD 5/140 OS 6/140	OD CF 10" OS 3/140	Po Pre	-
03	OD LP OS 1/200 (Snellen)	OD 1/200 (Snellen) OS CF 10"	Po Pre	+
04	OD MO OS 1/200 (Snellen)	OD MO OS 4/140	Po Pre	+
05	OD MO OS 4/140	OD MO OS 5/140	Po Pre	+
06	OD 6/140 OS --	OD 2/200 (Snellen)	Po Pre	-
07	OD -- OS LP	OD -- OS CF 14"	Po Pre	+
08	OD LP OS LP	OD CF 3" OS 2/140	Po Pre	+
09	OD 2/140 OS 2/140	OD 5/140 OS 3/140	Po Pre	+
10	OD -- OS CF 14"	OD -- OS CF 14"	Po = Pre	0
			x =	2

$p\ (x = 2,\ N = 9) = .180$

The probability associated with two negative signs and seven positive signs ($N = 9$) was .180 which is below the .05 level of significance; therefore the hypothesis of a significant gain in recorded near vision of experimental Ss could not be supported.

Subhypothesis IIa. That there would be a significant difference between experimental and control group post-experiment recordings of near vision acuity. By use of the signs test, six experimental Ss had acuity recordings greater than their matched controls (Table 8) whereas four recordings of control Ss exceeded their experimental pairs. The probability of the occurrence of four negative signs and six positive signs was .754 which failed to support the hypothesis of a significant difference between postexperiment recordings of the groups.

Subhypothesis IIb. That there would be a significant difference between experimental and print comparison post experiment recordings of near vision acuity.

The Mann-Whitney U test, a nonparametric test comparable to the unrelated groups _t_ test (Formula 6.7a, Siegel, 1956) was applied to the postexperiment recordings of the two groups. The observed U of 15.5 in Table 9 showed a significant difference ($U = 15.5$, $N_1 = 10$, $N_2 = 10$, $p < .02$), and led the investigator to conclude that the postexperiment

Table 8

Differences in Near Acuity Recordings of Experimental and Control Groups by Postexperiment Recordings

Subject	Postexperiment Recordings			
	Experimental	Control		Sign
01	OD -- OS 5/140	OD 2/200 (Snellen) OS 2/200 (Snellen)	E > C	+
02	OD CF 10" OS 3/140	OD -- OS 2/140	E > C	+
03	OD 1/200 OS CF 10"	OS -- OD 2/70	E < C	-
04	OD MO OS 4/140	OD 3/140 OS 1/140	E > C	+
05	OD MO OS 5/140	OD 2/200 (Snellen) OS 2/200 (Snellen)	E > C	+
06	OD 2/200 (Snellen) OS --	OD LP OS 3/140	E < C	-
07	OD -- OS CF 14"	OD 2/140 OS --	E < C	-
08	OD CF 3" OS 2/140	OD 1/200 (Snellen) OS 1/200 (Snellen)	E > C	+
09	OD 5/140 OS 3/140	OD 1/200 (Snellen) OS 1/200 (Snellen)	E > C	+
10	OD -- OS CF 14"	OD CF 10" OS 1/200 (Snellen)	E < C	-
				$x = 4$

$p\ (x = 4,\ N = 9) = .754$

Table 9

Differences in Near Acuity Recordings of Experimental and Print Comparison Groups by Postexperiment Comparisons

Experimental Recording	Rank	Print Comparison Recording	Rank
OD 5/140 OS 3/140	13	OD 14/70 OS 10/140	20
OD MO OS 5/140	12	OD 14/140 OS 14/140	19
OD -- OS 5/140	11	OD 7/140 OS 10/140	18
OD MO OS 4/140	10	OD 10/140 OS LP	17
OD CF 10" OS 3/140	8.5	OD 8/140 OS 5/140	16
OD CF 3" OS 2/140	6	OD 6/140 OS 6/140	15
OD 2/200 (Snellen) OS --	4	OD CF 14" OS 7/140	14
OD -- OS CF 14"	2.5	OD 3/140 OS CF 10"	8.5
OD -- OS CF 14"	2.5	OD -- OS 3/140	7
OD LP OS CF 10"	1	OD CF 6" OS 3/200 (Snellen)	5
Total	R_1 = 70.5		R_2 = 139.5
U	15.5		

$U = 15.5,\ N_1 = 10,\ N_2 = 10,\ p < .02$

near vision acuities of the experimental group did not approximate those of the print comparison (criterion group).

Although present ability or the acquisition of print reading ability was not expected for the blind children with remaining vision, the high pretest scores of some Ss suggested that a quantitative measure would reveal some possibility of word recognition and elemental reading ability. Consequently, Form One of the Word Recognition Test (PWR) and the Sentence Reading Test (PSR) of Gates Primary Reading Tests (1958) was administered to them in regular size type and without time extension at pretesting. Form Two of the same tests, plus the Paragraph Reading Test (PPR) were administered at posttesting to the same Ss and their matched controls, as well as to other experimental Ss who had demonstrated word recognition and/or elemental sentence reading ability.

The print comparison (criterion) group was included in the experiment in order to provide objective evidence of the visual efficiency of a group of blind children with varying degrees of vision, and as a possible goal of visual potential for experimental Ss.

The grade level scores recorded in Table 10 denote that experimental Ss who had some word recognition and elemental reading ability prior to the stimulation lessons increased in their grade level scores in a comparable manner to the increases shown by the print comparison (criterion) Ss, and exceeded the grade level scores of three of the print comparison group. Three experimental Ss who gave no indication of word recognition ability at pretesting gained scores beyond the first grade level by the conclusion of the experiment, and one second grade child acquired a 1.50 grade equivalent on paragraph reading.

Table 10

Grade Equivalents for All Groups on

Gates Primary Reading Tests

Subject No.	Experimental Group						Control Group			Print Comparison Group	
	PWR		PSR		PPR		PWR	PSR	PPR	PPR	
	Pre	Post	Pre	Post	Pre	Post	Post	Post	Post	Pre	Post
01	2.35	2.78	2.17	2.17	--*	2.35	1.55	0.00**	--	2.40	2.33
02	1.80	2.10	--	2.13	--	2.20	2.27	0.00	--	4.10	4.40
03	--	1.70	--	--		--				2.83	3.20
04	--	2.00	--	0.00		1.50				2.60	2.83
05										3.20	2.78
06										2.40	3.20
07										2.50	2.70
08	--	1.70	--	--	--	--				2.33	2.40
09										2.30	2.27
10										1.50	1.50

* -- indicates that the test was not administered.

** 0.00 indicates that an attempt was made to administer the test, but S refused to attempt it, or was unable to obtain a score.

Summary of Findings

The results of this experiment presented important evidence from which to infer that a planned sequence of lessons in visual discrimination and recognition would enable such children to acquire significantly higher scores on The Visual Discrimination Test. The mean gain of the experimental Ss was significantly greater than the mean gain of the matched controls. The mean gain for the experimental group exceeded the mean gain for the print comparison (criterion) group far beyond the .05 level of significance.

Although children receiving the lessons in visual stimulation increased their visual functioning and/or efficiency as measured by The Visual Discrimination Test, and six of the ten experimental Ss registered an increase in near acuity recordings between testings, significant changes in near acuity did not occur in the group as a whole.

Two experimental Ss progressed to such an extent in visual recognitions that they substantially increased their word recognition and reading ability to almost third grade level as measured by Gates Primary Reading Tests (1958). A few others who evinced no word recognition ability prior to the experiment, developed beyond the first grade level during the short treatment period.

The data of this experiment strongly suggest that blind children with remaining vision could improve their visual efficiency to the degree that they would be able to use their low vision more effectively for educational purposes if a planned sequence of visual stimulation were available to them in their early school years. A short period of intensive and individualized teaching demonstrated the possibility of changing the visual performance of children as measured by a test of visual discrimination. The increase of more than 10 points in the mean score of experimental Ss was measured by pretest and posttest administrations of The Discrimination Test by qualified educational testers other than the investigator. All children receiving the visual stimulation lessons increased their test scores from five to 21.5 points except for one S whose score remained about the same on both testings.

No correlations between increases in visual efficiency and chronological age, grade level, or intellectual ability appeared feasible with such a small sample, nevertheless, a general trend was obvious. Children who scored lowest in visual discriminations at pretesting exhibited a tendency to acquire higher gain scores than those who scored above the mean of the group. This occurrence seemed to have little relation to other identifying characteristics of the children, or to the number of lessons completed. These children may have experienced less encouragement or opportunity to develop control of fixation or to communicate in terms of the things they had been able to see previously.

Evidence from this experiment gave no support to significant changes in near vision acuity recordings as a result of the visual stimulation. Nevertheless there were noticeable increases in the near vision acuities of the children with the lower degrees of vision. Many of them were also among the children who demonstrated the greatest gain in test scores. Ophthalmologists (Ehlers, 1953; Hildreth, 1947) have suggested that visual acuity may be determined by the mental capacity of the individual. It appears logical to assume that in some instances, the improvement in visual efficiency may actually be a matter of increased perceptual abilities, in which case an increase in visual acuity could accompany visual stimulation. Because half the experimental Ss were totally without sight in one eye or had more sight in one eye or the other, The Harris Test of Lateral Dominance was administered in order to observe any possible consistency between the dominance pattern and the rate or extent of progress in visual discrimination. Children who had sight only in the left eye and two others whose sight was better in the left eye indicated a left dominance, but a mixed hand dominance was present in each case. Ironically, these children exhibited the highest gain score on The Discrimination Test and two of them,who had no previous knowledge of words in printed symbols, did attain visual word recognition and sentence reading ability. No relationship between dominance patterns and dominance theories (Dearborn, 1933; Harris, 1961; Hinshelwood, 1917; Orton, 1937) was suggested by the performance of this group of children.

The entire visual stimulation program was designed and taught without prior knowledge of specific competencies or inabilities of individual children in any phase of the planned lesson sequence. Consequently, all children received the same visual stimulation for the lessons which were completed by all Ss. However, it was interesting to note that the rate and number of lessons completed varied from a minimum of 29 lessons presented to one S while two others received as many as 56 different lessons in visual stimulation (Figure 6).

One child, previously mentioned, who was included in the experiment originally, was removed from the program at the request of her parents who were both totally blind. They stated that the lessons were "making her nervous, and besides she was getting too smart about what she could see." Initially, this child gave little indication of any previous use of her low vision, had little apparent ability to fixate,

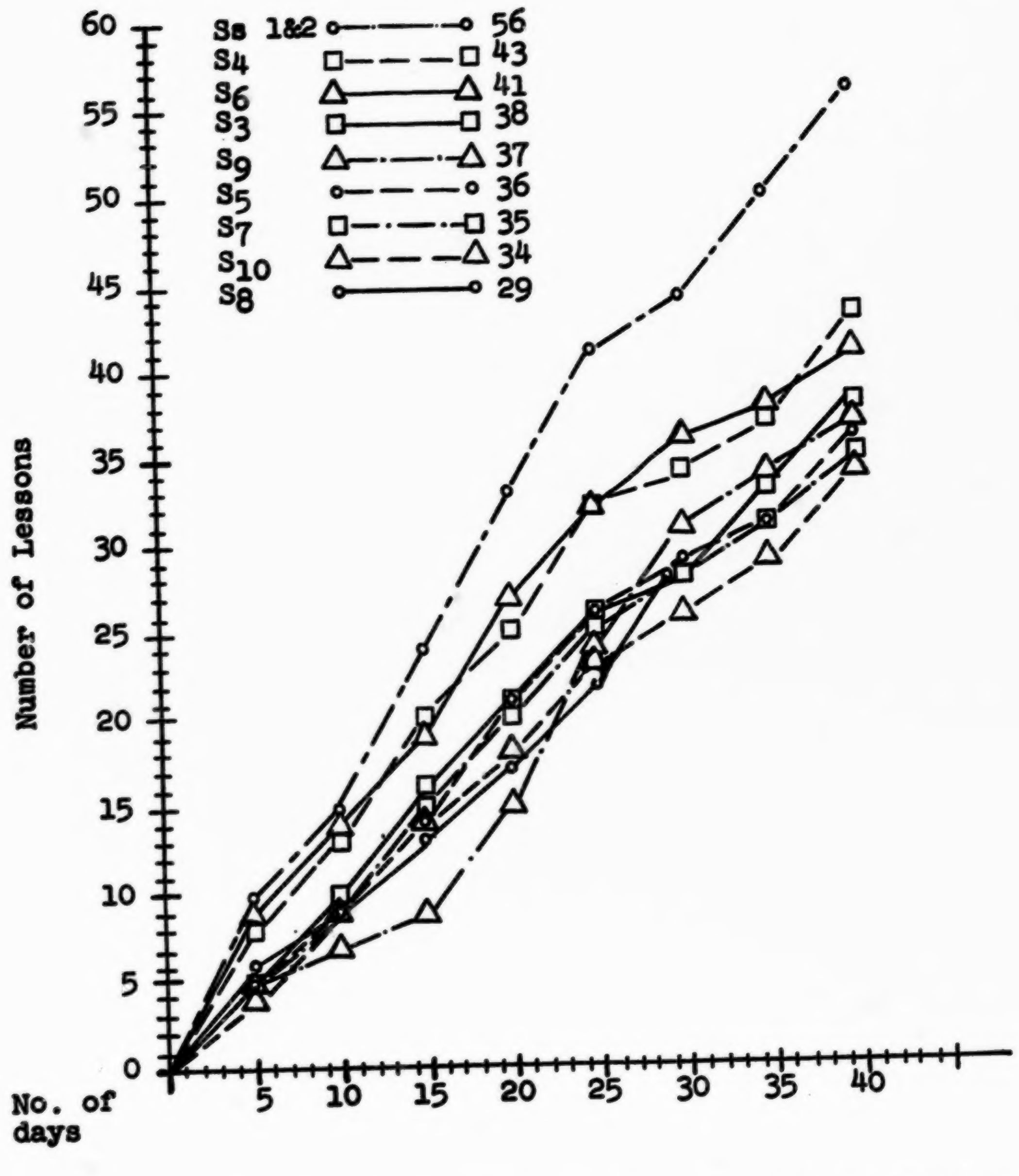

Figure 6. Progress chart of experimental Ss showing number of lessons completed and rate of progress.

and experienced extreme difficulty in identifying a near point at which she could see best. Her pretest score was the lowest acquired by any experimental S. During her 17 days of participation, she completed 15 lessons (with a minimum score), and was interested and fascinated by the variety of materials available which she could see. She was commenting, voluntarily, on the discriminations she made, and relating them to previous experiences with perceptions of familiar objects. Her classroom teacher observed that during her participation in the experiment she was carefully looking at picture books and recognizing some objects correctly, an activity in which she had never before participated. Upon termination of her lessons, she gained three points (20) over her pretest score (17), but by the close of the experiment (when she was tested again), her score was about the same as her pretest score (16). The investigator conjectured, "How far could she have progressed if she had been permitted to continue for the full sequence?"

Not only did the children appear to profit from the visual stimulation itself, but they obviously enjoyed the variety of visual activities, and the individualized attention given to foster accurate discriminations and recognitions. The "Hawthorne" effect seemed to function as an integral part of the program.

The desirability of individual attention to each child with low vision in order to provide visual stimulation and to teach the meaning of visual forms has been suggested by eye specialists for many years (Bier, 1960; Dorman, 1949; W. B. Lancaster, 1949; Sloan, 1956); however, this experiment is believed to be the first to utilize controls, enlarged and adapted materials, an especially designed instrument for evaluation, and a detailed outline of experience to demonstrate the significance of visual stimulation for blind children with remaining vision.

The fact that near vision recordings of certain children increased during the experimental period, but no significant change was evident for the group as a whole lends support to the suggestion of Bier (1960) that a medically determined index of acuity may not be an adequate evaluation of potential visual efficiency with educational materials.

The findings of this experiment give objective evidence that children with low degrees of remaining vision (6/200 or less) can improve significantly their visual efficiency by use of appropriate educational materials. Valid support is offered for further testing of the hypothesis given highest priority by the conference on research related to the education of visually handicapped children, "that children with all degrees of residual vision can achieve greater visual efficiency" (U. S. Dept. of H. E. W., 1961, p. 5).

Implications for Education

The evidence of this experiment strongly suggests that the visual functioning of blind children with remaining vision can be enhanced significantly by a short period of specifically planned lessons in visual stimulation for discrimination and recognition of educational materials. The detailed plans and the discrimination test included in this study may be used in instituting exploratory programs for blind children with remaining vision.

Apparently, for children whose clinical eye reports indicated extremely low degrees of distance vision, educators have erroneously assumed, to the present time, that no useful near vision was present or could be developed. Probably due to the lack of information about these children, little effort has been made to present visual materials along with auditory and tactual media unless children themselves possessed sufficient curiosity and drive to supplement their learning by visual means. The progress made by Ss in this experiment suggests that a more comprehensive appraisal of each child and his efficiency in all media be extended over a period of several months before the decision is reached that he is unable to profit from use of visual materials. Neither distance acuity measures nor near vision indices are adequate to appraise the potential for progress with appropriate visual materials.

Perhaps a logical procedure would be to place children with low degrees of remaining vision in separate groups upon school entrance, and provide a more individualized and sequential program of reading readiness with visual, tactual, and auditory materials. After an appropriate length of time, objective appraisal and qualitative analyses of individual children's interest in "learning to see" should give the teacher more definitive guides for planning for each low vision child.

Aside from the fact that, with the exception of one, all children included in the experiment made measurable progress in visual activities, qualitative data revealed startling deficits in vocabulary development, which precluded their ability to communicate meaningfully about their visual discriminations. The need for consistent near point observations is apparent, but the necessity for individualized assistance in verbal responses concerning visual discriminations is also essential in the acquisition of recognition clues about things they are able to see.

The vocabulary deficit was noted also in the intellectual evaluations of experimental Ss. Though many of the children passed several items from one to three years above their chronological age, not one of them exceeded his age level in vocabulary items, and many were well below their age level in word knowledge. The majority of children (regardless of age and grade level) were limited in the use of descriptive terms essential to comprehension of reading material in any media. Teachers should be especially cognizant of the need for exploration of the experience background of children who have relied previously on tactual and auditory learning methods before introducing them to reading material which may have little meaning to them conceptually.

Administrators and teachers should give serious consideration to the feasibility of separating "borderline" low vision children (who have recorded distance acuities from light perception up to 10/200) from totally blind children until definitive appraisal can suggest the most appropriate media for their learning. Even when it appears that a particular child must rely on tactual and auditory media for his primary learning, continued visual stimulation and reappraisal should be encouraged. The developmental processes of visual and perceptual learning suggest the possibility of the concurrent use of all media as a logical procedure (Gesell, 1959; Hake, 1957; Hebb, 1949; Montessori, 1914), rather than a premature and arbitrary decision of either braille or print for reading. The qualitative observations of this investigation implied that after learning has accrued by use of specially prepared and enlarged materials, the transition to smaller stimuli and type size may be relatively easy for many children.

No specific suggestions are plausible in regard to the relation of monocular vision and hand dominance from this experiment, however provision for and encouragement in the establishment of dominance in either hand may be of importance since mixed hand dominance has been associated with a number of reading disability cases (Harris, 1958).

The Visual Discrimination Test and accompanying detailed lesson plans in visual stimulation are presently the only known materials available for educational appraisal and visual stimulation of children with extremely low vision. With additional evidence from teachers as to their effectiveness, revisions can be made which should provide the necessary refinement to verify their use in measuring the differential effects of current decisions and procedures on the visual efficiency of blind children with remaining vision.

Implications for Research

Follow-up studies of children with experimentally elevated visual efficiency seem indicated in order to determine whether the gains in visual functioning and behavior will be maintained, increase, or regress to former levels. The important variable of the desired number of lessons and the optimal amount of time for each lesson, may influence the stability of acquired efficiency and the motivating effects of the stimulation. Prolonged assistance and encouragement may be an enhancement to some children while others may simply need to be taught identifying clues for visual stimuli.

The lack of change in the control group suggests also the possibility of differential influences in administrative and teacher attitudes on the visual behavior of children in certain schools. Experimental studies in a number of schools which have different policies which influence the determination of visual functioning would eliminate the inferential limitations of a single study.

A longitudinal control study of low vision children which provided planned visual stimulation throughout the early school years, and included regular educational and psychological appraisal would provide invaluable evidence for educators. Specific variables could be isolated for additional study to determine individual characteristics which influenced the functional visual behavior of blind children with remaining vision.

The effects of visual stimulation upon braille reading ability should be explored to ascertain whether the visual stimulation alone or the progressive lessons were producing the desired changes in visual behavior. Those children with low vision who have difficulty in reading braille might be enabled to improve their reading skill by more individualized attention to readiness preparation, and/or by supplementary print reading materials. Experimentally induced enhancement of visual efficiency might permit some children to use both print and tactual media concurrently with their other channels of learning. A study of the characteristics of children using both print and braille compared to those children who depend on either medium alone (Jones, 1960) should reveal pertinent information regarding the visual efficiency of blind children with remaining vision.

With increased interest and skill in the perfection of optical aids, still further research is indicated along this line. If children can increase their visual efficiency without the use of aids, then teaching experiments in visual stimulation with the use of optical aids should be investigated. Possibilities for further research similar to the present study appear to be unlimited since no educational or psychological studies to date have dealt with this particular group of children. They are small in number, but very important in nature.

SUMMARY

The purpose of this teaching experiment was to study the effects of specialized instruction with appropriate materials on the visual behavior of blind children with remaining vision. The investigator sought to determine if the visual functioning of young children could be significantly increased in a short eight week period as a result of intensive individualized teaching with appropriate materials. The changes in visual efficiency were measured by The Visual Discrimination Test, designed specifically for the study because of the lack of a suitable standardized instrument.

The literature was shown to suggest the ongoing development of the visual process through maturation, and in spite of anomalies of the eye which may hamper the development of visual processes, training and experience appear to act as ameliorating forces in the improvement of visual efficiency (Gesell, 1959; Law, 1960). Eye specialists (Bier, 1960; Ehlers, 1953; Hildreth, 1947) stated that the sharpness of vision had no one true value, but was as variable as individuals themselves, and that in children with low degrees of vision, functional behavior was a matter of learning.

Theoretical hypothecations and psychological experiments made it logical to assume that low vision children may progress in their abilities to conceptualize from visual experiences within the limits of their visual defects and intellectual capacities. Verification of this assumption was inferred by Brown's (1961) notion that one must be prepared for seeing by the "input and confirmation of information from the environment," and that "visual response is to a considerable degree, a learned response."

The paucity of educational research regarding the effects of visual impairments, and the lack of experimental research designed to evaluate visual behavior led to the identification of "training and/or learning to see" as the number one problem facing educators working with visually impaired children.

The subjects in this experiment consisted of ten pairs of blind children with remaining vision matched on pretest scores on a test of visual discrimination containing items adapted from reading readiness materials. Educational materials previously presented to these children had consisted of auditory and tactual stimuli, and no instruction in the discrimination and recognition of visual materials had been offered them in the classroom. A print comparison group which was designated as the criterion group was included also for study. Children comprising this group had only slightly higher recorded distance acuities, but were all using their vision as their primary means for learning. All of the children included in the investigation were between six and 13 years of age, had Interim-Hayes-Binet IQ's above 80, and were in grades one through five in a residential school for the blind where they had attended since first grade. They were free of any known abnormalities (other than defective vision) which would present additional learning problems.

The experimental children were taken from their classrooms in pairs for daily 45-minute periods over the two month treatment period. An enriching program in visual stimulation for development and improvement of functional use of low vision was planned and taught by the investigator. An effort was made to induce each child to "learn to see" by offering discriminatory clues to be associated with previously experienced stimuli to enhance visual recognitions. Review of the previous lesson preceded the introduction of new material each day, and when necessary, entire lessons were repeated two or three times. The entire program was aimed at an overall development of readiness for educational learning by initial use of enlarged materials with high visual appeal prior to the presentation of readiness and primary materials in smaller size and type. The investigator chose to plan and teach lessons for general visual enhancement rather than remediation of specific inabilities; consequently, the pretest performances of children (except for their total scores) were unknown to the investigator until the conclusion of the experiment.

The lessons were planned to evoke maximum proficiency in attention to communication and interpretation of visual observations. Specific activities and lesson plans for the program were developed to follow the four sequential stages for discrimination and recognition of visual stimuli: geometric forms in solid black and in outline shapes; single object forms in solid black and in outline shapes; grouped objects in color and in outline with full inner details; and letter and word symbols. All materials decreased gradually from two inches to one-fourth inch in size down to large type size of a Smith-Corona portable electric typewriter, which had sans serif type spaced at six letters per inch.

Each lesson was carefully planned so that adaptations were possible in order to provide for variations among individuals. Lessons began at the same level for all children, but the rate of presentation varied according to the aptitude and visual functioning of individuals. Evaluation of progress was made by daily score ratings and recorded observations. The Harris Test of Lateral Dominance was administered to the children for consideration of the relation of dominance patterns to the overall performance in visual functioning.

Maintaining the .05 level of significance throughout, an analysis of variance determined the effectiveness of the treatment on the test scores of all groups between the two testing periods. A significant interaction validated the use of appropriate _t_ tests to determine the significance of the differences within individuals and among the different groups. The mean difference in gain scores for experimental Ss was analyzed by use of the t test for related measures. The t value of 4.41 indicated that a highly significant (.005) difference existed in the test scores of children in the experimental group at the conclusion of the experiment. Substantial gains were noted in all subject's scores with the exception of one. The difference in the experimental and control group mean gain (matched pairs t test) yielded a t value of 2.78, significant beyond the .05 level of probability. Eight of the ten experimental children achieved gain scores greater than those of their matched controls. The t test for unrelated measures was used to determine the difference in mean gain between the experimental and print comparison (criterion) groups. The t value of 2.90 provided evidence of a significant (.05) difference in mean gain scores between these groups at the conclusion of the treatment period. These data confirmed the investigator's first hypothesis that a planned program of visual stimulation would enhance the visual functioning of individual experimental Ss, and of the experimental group over that of the control and print comparison (criterion) groups, as measured by The Visual Discrimination Test.

Near vision acuities were recorded by an ophthalmologist to determine whether or not an increase in near acuity recordings would accompany changes in visual behavior of experimental Ss. The nonparametric signs test was utilized to determine the significance of the increases. Although positive increases were noted for seven of the ten Ss, the mean increase could not be accepted as significantly different. Seven experimental Ss had postexperiment recordings greater than those of their matched controls; however no significant difference was evident between the two groups. The postexperiment near acuity recordings of three experimental children were equal to or greater than those of some children in the print comparison (criterion) group, but this difference could not be considered significant. These data failed to provide evidence that the recorded near vision acuities would increase or be significantly different between groups as a result of visual stimulation for a short period of time. In spite of the lack of definitive support, children with the lowest degrees of vision appeared to have greater increases in near acuity recordings than did those whose vision was higher initiall

Analysis of the pretest and posttest scores of all groups permitted additional investigation of the reliability of The Visual Discrimination Test. A correlation of control and print comparison subjects' pretest and posttest scores over the two month period gave a test-retest stability coefficient of .98.

On the basis of these findings, it was concluded that this study:

1. Presented evidence which provided objective verification of the value of visual stimulation programs for blind children with remaining vision.

2. Demonstrated that a short-term intensive teaching procedure would increase significantly the visual efficiency of low vision children in the first five grades.

3. Contributes to the literature a detailed set of lesson plans and suggested materials which might be used in future educational programming or research.

4. Provides a reliable instrument for evaluation of the visual functioning ability of blind children with remaining vision by use of enlarged and adapted educational materials.

5. Revealed a need for continuous comprehensive appraisal of each child and his efficiency in all learning media before deciding that visual materials are unsuitable for his use in the classroom.

6. Suggests the possibility of the enhancement of educational opportunities for low vision children by presentation of appropriate visual materials to supplement tactual and auditory media in present use.

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APPENDIX A

Visual Discrimination Test

Lesson Plan Sequence

Daily Lesson Plans

Materials Used in Visual Stimulation Program

VISUAL DISCRIMINATION TEST

General Instructions:

This test should be referred to as a game to play. At no time should the children hear it called a test. It is suggested that one person administer the test to no more than three to five children at any one time.

The person giving the test should be sure that each child understands the instructions clearly for each item (repeat as many times as is necessary and demonstrate). As much time as is necessary should be allowed for the test (teacher should use her own judgment). It is particularly important that the teacher check to see that each child has his finger on the correct box, and looks at all the items in that box before making his choice.

If any child has difficulty keeping his place, a cover sheet may be used to expose one box or row at a time. Children should be permitted to hold the page as close as is necessary for them to see the items.

No indication should be given the child as to whether or not his choice is correct. If he/she inquires, just say "that's fine" or something similar. The test is designed so that no child should be able to succeed on all items of the test. Every item should be attempted, but in case the child says he is unable to see the item, he may omit that one, and go to the next one.

Specific Instructions

Distribute the tests to the children with a red pencil, and say, "We are going to play a new game. I want to find out how many pictures and drawings you can see by looking at them with your eyes. I want you to listen carefully to everything I say, and to mark only when I tell you."

Turn to the demonstration sheet. Always refer to the items as forms, figures, pictures or letters, never to any item by its name.

Explain the following terms until you are sure the children understand each one:

1. Row
2. Box--show how to find a big box, and a little box.
3. Forms--solid black items.
4. Figures or pictures--items which have only outline shapes and/or inner details.

5. Letters--big letters and little letters (do not call by name).
6. Words--a group of letters that say something.
7. Making an X--drawing a line through a word. Let the children practice.

Please do not give any assistance in choice or marking of actual test items.

Test I

(You will note a number in each row or box to which the following instructions refer:

1. Say, "Put your finger on the first box (show children). Mark the stick that does not look like the others" or "is different."
2. Say, "Move your finger over to the next box. Look at the stick in the little box, then mark the one in the bigger box that is just like it."
3. Say, "Move your finger to the next row. Look at the stick in the little box, then mark the one in the row that is just like it."
4. Say, "Move your finger to the next row, and mark the form that does not look like the others."
5. Repeat instructions for No. 4.
6. Say, "Move your finger to the next row. Look at the form in the little box, then mark the one in the row that is just like it."
7. Repeat instructions for No. 6.
8. Say, "Turn your page, and put your finger in the first row. Look at the first form--then look at the form next to it--something is missing--find the piece that is missing and mark it."
9. Say, "Move your finger over to the next box, and mark the cross."
10. Say, "Move your finger to the next row. Look at the form in the little box, then mark the one in the row that is just like it."
11. Say, "Move your finger to the next row. Look at the form in the little box, then mark the one in the row that is just like it."

Test II

Please direct the children to move their finger to the next box or the next row as appropriate, so you can be sure they are able to keep the place.

12. "Look at the pieces in the little box, then mark the form in the bigger box that could be made from those pieces."
13. "Look at the pieces in the little box, then mark the figure in the bigger box that could be made from those pieces."
14. "Mark the figure that is different from the others."
15. "Look at the figure in the little box, then mark the one in the row that is just like it."
16. "Turn to the next page and put your finger in the first row. Mark the figure that is different from the others."
17. "Look in the first box, and mark the key."
18. "Look over in the next box, and mark the spoon."
19. "Mark the one that you could wear."
20. "Mark the one you could play with."
21. "Mark the picture that is different from the others."
22. First box--"Mark the picture that is different from the others."
23. Second box--Same as for No. 22.
24. "Mark the picture that is out of place."
25. "Look at the picture in the little box, then mark the one in the bigger box that goes best with it."
26. "Turn to the next page. Put your finger in the first row. Look at the first picture, then look at the one next to it--something is missing--find the little piece that is missing and mark it."
27. "Mark the picture that is different from the others."
28. "Look at the first picture, then look at the other pictures. Mark the one that is just like the first one."
29. "Look at the first picture--something is missing--find what is missing and mark it."
30. "Move your finger over to the next box. Look at the figure in the little box. Now look at the figure in the bigger box--something is missing--mark the part that is missing."
31. "Look at the pieces in the little box. Find the picture in the bigger box that could be made from the pieces and mark it."
32. "Look at the picture in the little box, then mark the picture in the bigger box that is just like it."
33. Repeat instructions for 32.
34. "Mark the cow."

Test III

35. "Turn the page, and put your finger in the first row. Mark the letter that is different."
36. "Mark the letter that looks different from the others."
37. Repeat instructions for 36.
38. "Mark the letter that is different from the others."
39. "Mark the E."
40. "Look at the letter in the little box, and mark the one in the bigger box that is like it."
41. "Draw a line through the word that is different."
42. "Mark the letter that is different."
43. "Draw a line through the word that is different."
44. "Draw a line through the word that is different."
45. "Look at the word in the little box, then draw a line through the one in the row that is just like it."
46. "Draw a line through the word that looks different."
47. "Look at the word in the little box, then find the one in the big box that looks just like it--draw a line through it."
48. "Look at the word under the picture, then find the one just like it, and draw a line through it."
49. Repeat instructions for 48.
50. "Look at the box in the first row. Draw a line from the box to the word that will fit in the box."
51. "Look at the two boxes--draw a line from the two words to the boxes in which each will fit."
52. "Draw a line through the two words that look the most alike."
53. "Look at the two words in the little box--something is missing from the second one--find the letter in the bigger box that is missing, and mark it."
54. Look at the picture, then mark the word that goes best with the picture."
55. "Draw a line through the words that say 'go to bed'."
56. "Draw a line through the words that say 'that is funny'."
57. "Draw a line through the sentence that tells about the picture."
58. "Draw a line through the sentence that tells about the boy."

VISUAL DISCRIMINATION TEST

Please fill in the following information for each child:

Name of child____________________________Birthdate__________

Sex__________Grade________________Reading Medium__________
(Print or Braille)

Distance Visual Acuity (with glasses if worn): R.____L.____

Test Information

	Number right
Subtest 1	____________________
Subtest 2	____________________
Subtest 3	____________________
Total Score	____________________

Name of person administering and scoring____________________

For Demonstration Only

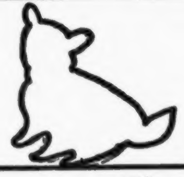
This is a row

This is a big box

This is a little box and a bigger box

This is a form

This is a figure



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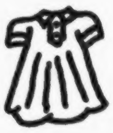


S B

These are big letters

These are little letters

e u y

These are words

City Baby

These are words that go together

come see Mother

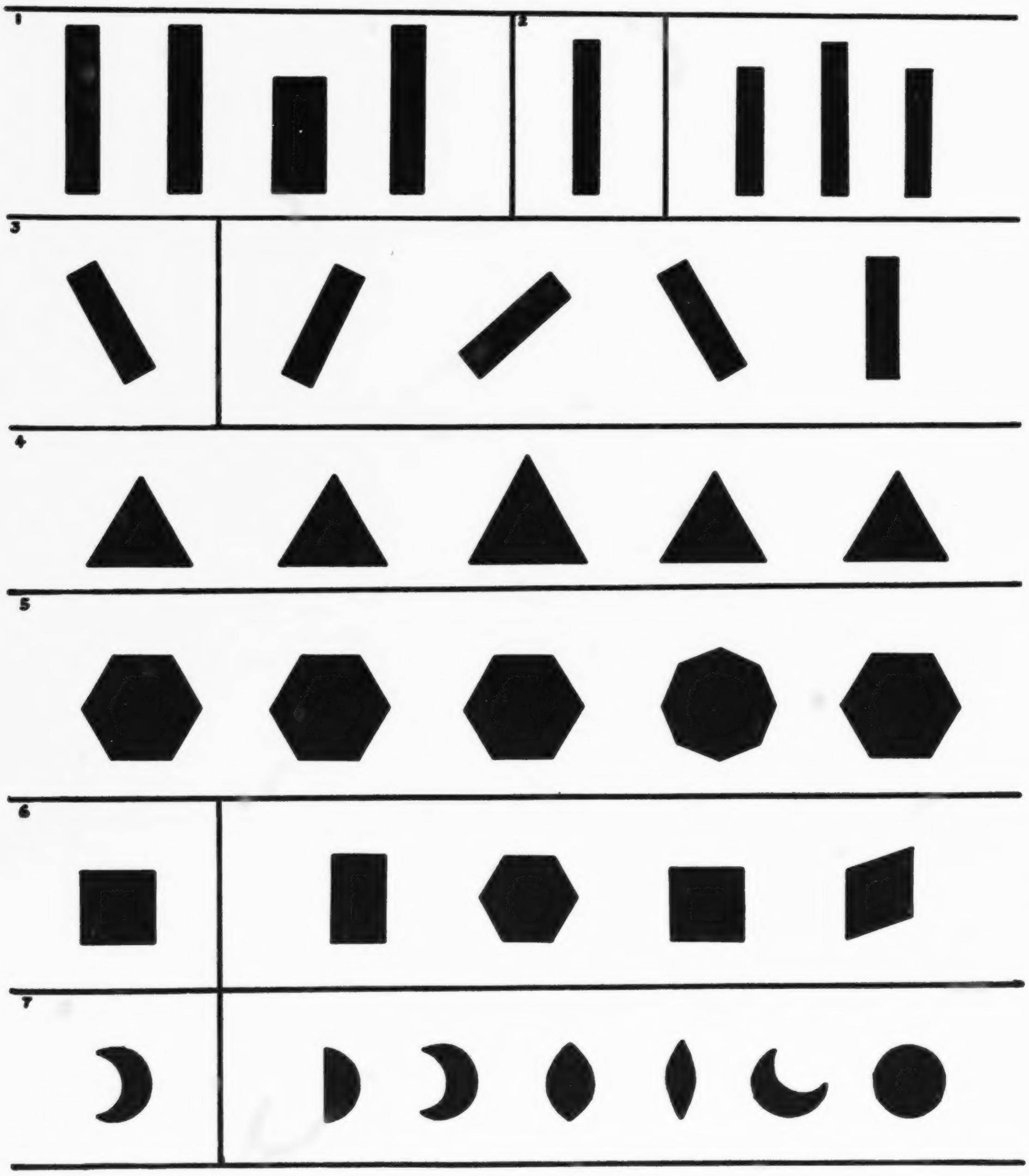
Mark an X on the letters

a b

Mark an X on the word

this

TEST 1



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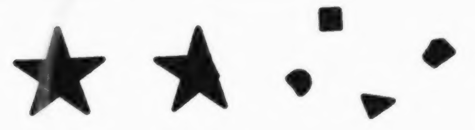

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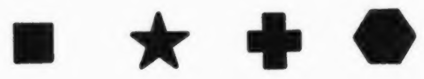

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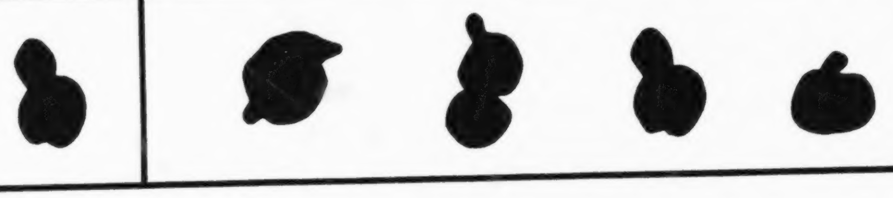

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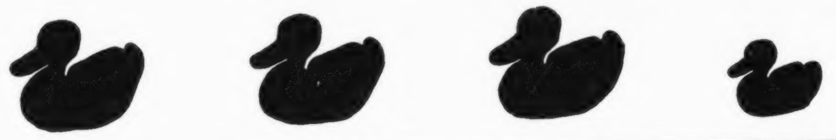

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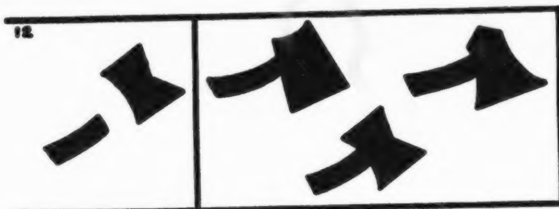

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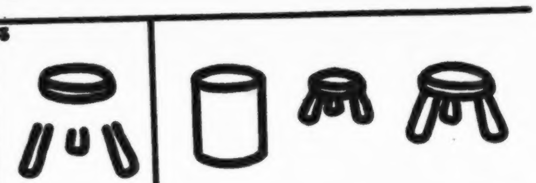

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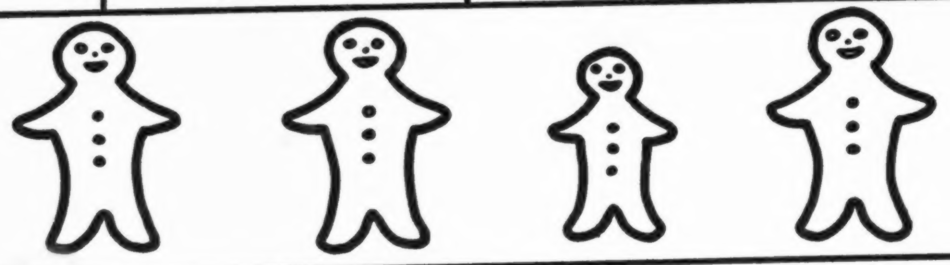

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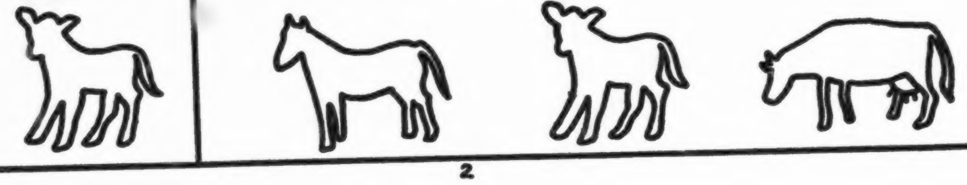

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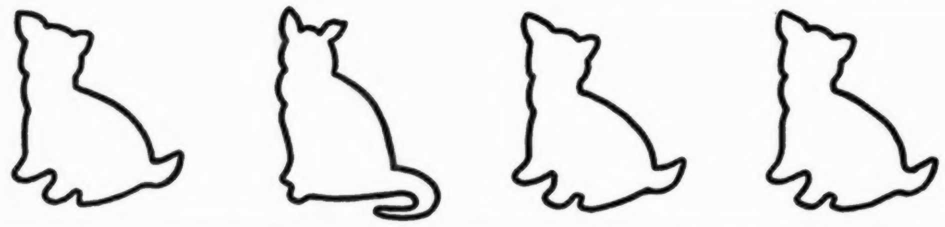

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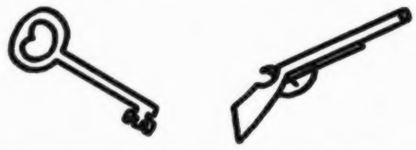

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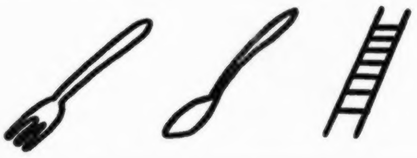

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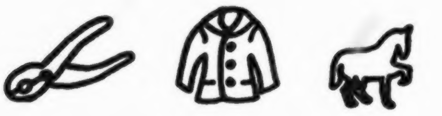

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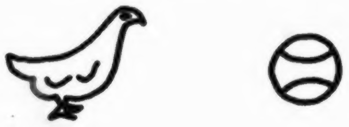

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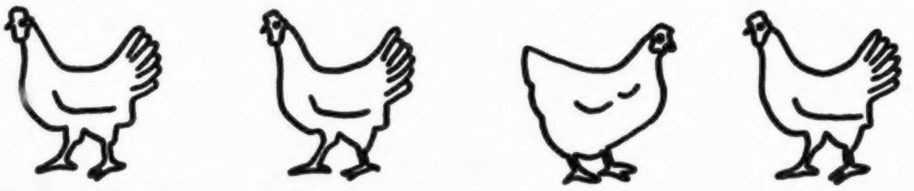

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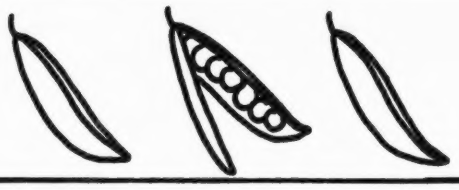

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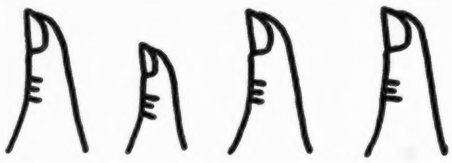

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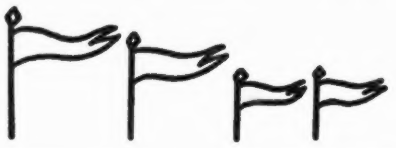

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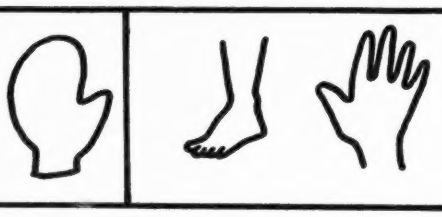

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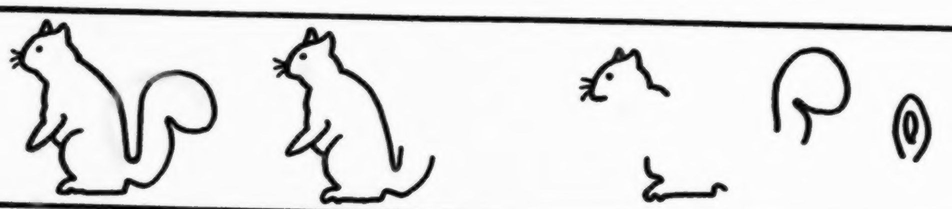

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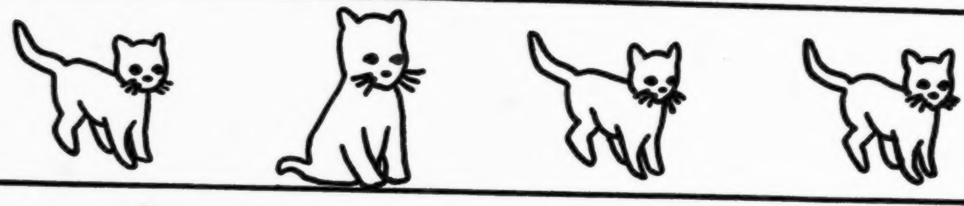

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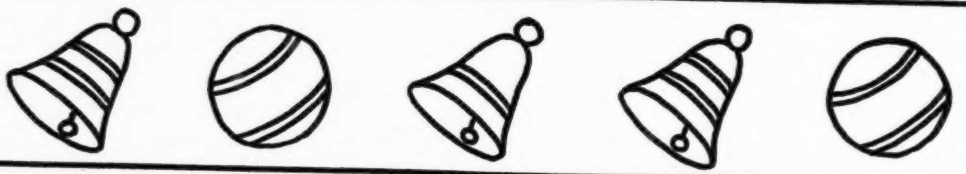

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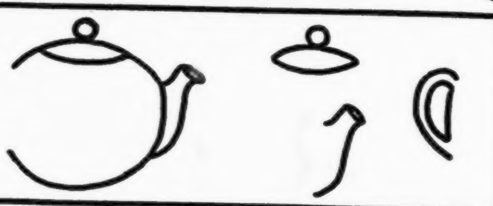

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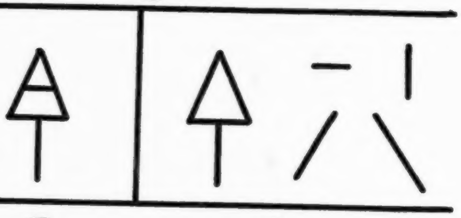

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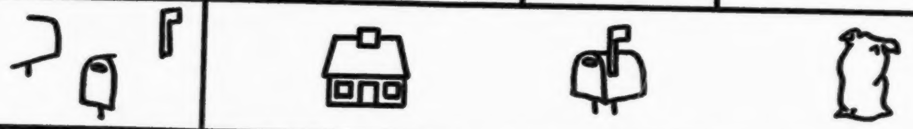

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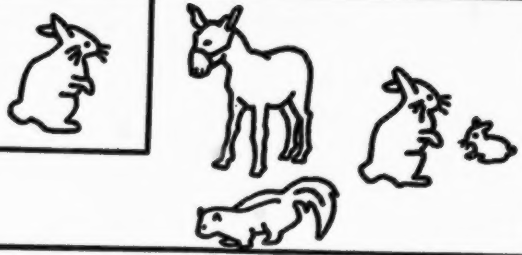

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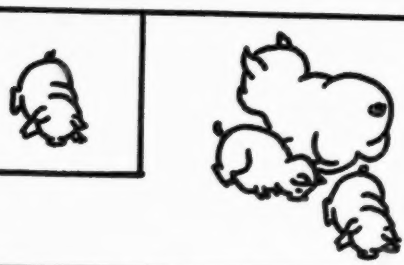

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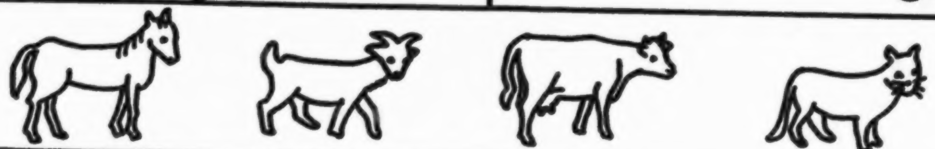


TEST 3

35 S S E S

36 M m M M

37 B B B B

38 P P R P

39 L E B A

40 h | k h t

41 b b d b

42 play jump play

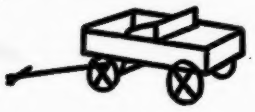
43 on on no on

44
Me My Me Me

45
ball
box ball call

46
and and and and

47
little
will mitten
kitten little

48

away wagon
wagon play woods

49

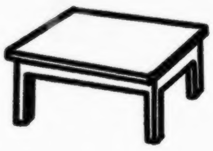
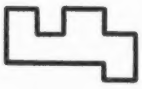



table thing
table three taller

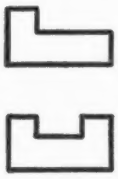
50



bottle
happy
daddy

51

fun
here
look



52

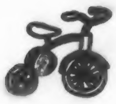
horse
had
here
house

53

baby
bab

y b
d l

54



run
ride
rock

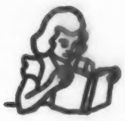
55

go for a ride
go to bed
go to bat

56

this is pretty
here is puppy
that is funny

57



She has a book.
It is raining.
This is a boy.

58

The ball is round.
The boy can run.
The boat is black.

LESSON PLAN SEQUENCE

Progressive Sequence of Lessons for Visual Discrimination and Recognition by Developmental Stages

Stage I. Tactual and visual stimulation for discrimination and recognition of geometric forms in solid black and in outline shapes; ordering for size and relationship in left to right progression.

Stage II. Visual stimulation for discrimination and recognition of object forms in solid black, outline drawings, and outlines with inner details with discussion of class categories, uses, and descriptive words.

Stage III. Visual stimulation for discrimination and recognition of individual objects within groups of objects; similarities and differences among objects; story sequence with pictures; figure-ground discriminations; discrimination and recognition of letter symbols.

Stage IV. Visual stimulation for discrimination and recognition of word symbols and word combinations with pictures; discrimination and recognition of sight words, phrases, and sentences without pictures.

DAILY LESSON PLANS

Lesson 1

Object: To make tactual discriminations of pegs of graduated heights and diameters. To understand sequential ordering of pegs by diminishing heights and/or diameters.

Materials: Three sets of pegs containing eight in each set.
- A. All 3" in height; diameters 3" to 3/16".
- B. All 1" in diameter; heights 4" to 1 1/2".
- C. 4" to 2 1/4" in height; 4" to 3/4" diameter.

Procedure:
- A. Introduction
  1. Teacher introduces herself and asks child to repeat her name as she repeats child's name.
  2. Teacher explains procedure of games to be played each day as she attempts to stimulate interest in learning to see the new materials and pictures to be presented.
- B. Game with tactual materials.
  1. Teacher presents child with first set of pegs.
  2. Teacher asks child to find the largest peg, the smallest peg, then to note differences in size of entire set.
  3. Teacher asks child to arrange pegs in order of size from largest to smallest or from tallest to shortest. In case of unnoticed misplacements, teacher asks child to reexamine by closing his hand around each peg.
  4. Set 2 presented--same procedure.
  5. Set 3 presented--same procedure.
  6. Repeat entire procedure by denoting smallest, then largest, and placing in order from smallest or shortest.

Conclusion:
- A. Teacher helps child to summarize what he has learned.
- B. Discuss activity for next day, time, place, etc.
- C. Teacher and child repeat each other's names.

Lesson 2

Object: To make visual discriminations of pegs of graduated heights and diameters. To understand sequential ordering by use of visual procedures.

Materials: Same as Lesson 1.

Procedure:

- A. Review
  1. Teacher and child exchange greetings by name.
  2. Ask child to recall what he did at last lesson.
  3. Discuss heights and sizes using appropriate words.
- B. Discrimination and Recognition Game
  1. Teacher presents first set of pegs lying on table, and asks child to play "a looking game." Attention is called to the differences in sizes and lengths. Child is asked to find the largest peg, then the longest one, the smallest one, and the shortest one.
  2. Child is asked to stand all pegs upright on the table, then place them in order of descending size or height without tactual exploration as nearly as possible.
  3. Teacher and child summarize appropriate descriptive words as child replaces pegs in board.
  4. Repeat the same procedure for each of the other sets.

Conclusion:

- A. Teacher assists child to summarize differences in visual terms.
- B. Teacher makes sure each child understands "out of place" pegs, and why they are called out of place.
- C. Prepare child for next day's lesson.

Lesson 3

Object: To teach visual discrimination and recognition of solid black forms of pegs on charts and cards.

Materials:
- A. 3 large charts containing solid black forms of pegs in ordered sequence.
- B. 2 sets individual cards corresponding to peg forms.
- C. 1 large chart with selected peg forms in scrambled order.

Procedure:
- A. Introduce "Seeing Game."
    - 1. Present each child with one card at a time in each set. Ask him to trace around the black form as teacher discusses with them the distances of finger movements. Call attention to the longest one, shortest one, etc.
    - 2. Teacher asks child to find all the cards on which forms look the same length; then all those that look the same width. Discuss likenesses and differences.
    - 3. Children play matching game; one child selects a card, and other child finds one to match it; vice versa until all cards are matched.
- B. Arrangement according to size.
    - 1. Teacher presents child with cards of one set, and asks him to place them in order from largest to smallest or longest to shortest. Repeat for other two sets.
    - 2. Teacher presents large chart with each set in replica. Child matches his cards to those on the chart.
    - 3. Teacher presents large chart with scrambled forms from all sets. Child is asked to choose and match corresponding forms.

Conclusion:
- A. Teacher reviews descriptive terms of forms as child chooses correct form to correspond to word.
- B. Discuss activity for next day, time, etc.

Lesson 4

Object: To teach discrimination of color; introduction of color names; matching of same or similar colors.

Materials: 5 sets wooden color strips, 1" wide, 3/8" thick in diminishing lengths (colors, red, blue, yellow, green, orange, purple).

Procedure:

A. Introduce "Color Game."
   1. Child is asked to give all the color names he knows.
   2. As the child names a color, teacher asks him to relate to known things, e.g. grass, fire, etc.

B. Color recognition.
   1. Present one stick of each color to child, and ask him to name the color; teacher supplies name if child does not recognize.
   2. Teacher presents child with set of sticks of unrecognized color, names color, and asks child to arrange the sticks in order of diminishing lengths.
   3. Repeat for all sets of unrecognized colors.
   4. Child arranges one set in diminishing lengths to include each color naming the color as he chooses it.

Conclusion:

A. Teacher asks child to name and identify all colors he has learned.

B. Child selects all the red sticks, etc.

C. Discuss plans for the next day, and remind him of lesson time.

Lesson 5

Object: To recognize 6 primary colors on paper, and to understand light and dark shades of colors.

Materials:
- A. Large chart with scrambled colors and light and dark shades.
- B. Individual cards containing light and dark shades of primary colors.

Procedure:
- A. Review color names with sticks.
- B. Teacher presents child with cards of colors in light and dark shades as she explains the difference.
- C. Child selects the two shades of the same color.
- D. Teacher scrambles cards and asks child to match his cards to large chart of scrambled colors.

Conclusion:
- A. Discuss colors in relation to objects in room and common objects seen daily.
- B. Teacher gives color name and child selects appropriate card.
- C. Child tells what he has learned during the week.
- D. Discuss plans for next week, and remind child of time.

Lesson 6

Object: To teach discrimination and recognition of circles, squares, and triangles presented in solid black.

Materials:

- A. Large chart containing a row each of solid black squares, circles, and triangles in diminishing sizes from 2" to 1/4".
- B. Large chart containing assorted sizes of each shape in scrambled order.
- C. Individual cards containing all sizes of the three shapes in solid black.

Procedure:

- A. Teacher presents child with 2" size of each shape. As child traces each with his finger, teacher calls attention to hand movements in terms of corners, points, curves, etc.
  - 1. Teacher gives child other cards with assorted sizes and asks him to separate according to shape.
- B. Discrimination of size differences.
  - 1. Child chooses the largest one of each shape, etc.
  - 2. Child arranges his cards in rows according to shape, and increasing in size from smallest to largest.
- C. Matching
  - 1. Present child with large chart in size sequence, and ask him to match his cards to those on the chart.
  - 2. Present chart with scrambled shapes and sizes, and ask child to match the appropriate one.
  - 3. Matching Game--each child presents one card and partner matches with same one.

Conclusion:

- A. Teacher asks child to select shape with no corners or points; shape with corners and straight lines; shape with points, etc.
- B. Plan for next day and remind child of time.

Lesson 7

Object: To teach visual discrimination and recognition of varied geometric forms with appropriate descriptive words.

Materials:
- A. Chart with solid black forms of polygons, rectangles, crosses, stars, ovals, crescents, diamonds, and half circles in diminishing sizes from 1 1/2" to 1/4".
- B. Individual cards to match forms on charts.
- C. Chart with outline drawings of same geometric designs.
- D. Individual cards with outline drawings in diminishing sizes.

Procedure:
- A. Present each form separately (use largest in size).
  - 1. Child traces outline of form with finger as teacher gives name and descriptive words.
  - 2. Teacher helps child to note and discuss similarity of lines to those of squares, circles, and triangles.
- B. Present sets of small cards (5 sizes of each form).
  - 1. Child chooses all cards of each shape.
  - 2. Child arranges cards of each shape from largest to smallest.
- C. Present large chart containing forms, and asks child to match individual cards to forms according to size.
- D. Repeat procedure for outline drawings of shapes.

Conclusion:
- A. Teacher asks child to choose shape most like square, circle, triangle, etc.
- B. Child chooses 5 shapes, and describes in terms of lines, size, and similarity to other shapes.

Lesson 8

Object: To teach recognition of names of geometric outlines and colored forms with appropriate descriptive words.

Materials:

A. Chart with outline drawings (from lesson 7).
B. Individual cards with outline drawings (from lesson 7).
C. Chart with all shapes in 6 primary colors.

Procedure:

A. Teacher gives name of each shape and supplies descriptive words as child traces and examines closely.
B. Child is asked to pick out all the squares, circles, etc.
C. Game.
    1. Teacher asks for specific shapes using either names or descriptive words or both.
    2. Review by placing each according to increasing or diminishing size.
    3. Teacher presents stimulus card and asks child to find square this size, etc.
D. Teacher presents selected work sheets for discrimination and matching.

Conclusion:

A. Repeat names of forms and descriptive words.
B. Plan for next day.

Lesson 9

Object: To encourage visual organization of Gestalt (whole) from observation of separate parts.

Materials: Ten geometric forms (2" size) cut into 4 pieces, (square, circle, triangle, hexagon, octagon, rectangle, cross, star, ellipse, and diamond). Individual cards of same whole forms.

Procedure:

A. Review:
   1. Child names each form as it is presented.
   2. Ask child to describe as to kind of lines, corners, points, etc.

B. Present picture of one form at a time, at the same time present same form cut in four pieces, and ask him to assemble to look like whole form.

C. Remove pictures of forms--present child with pieces of each form (one form at a time), and ask him to assemble from memory. Ask child to name each form as he assembles it.

Conclusion:

A. Teacher discusses appearance of individual parts of each form with child.

B. Teacher assists child in orientational placement of individual parts as child reassembles the forms.

Lesson 10

Object: To review color discrimination, and geometric forms and shapes.

Materials: Charts with colors, geometric forms and shapes. Individual cards for matching; individual work sheets for discrimination.

Procedure:

A. Flash drill
   1. Flash small card (10 to 15 seconds), ask child to point to same form on large chart.
   2. Repeat for colors.
   3. Repeat for outline shapes of figures.

B. Noting likenesses and differences
   1. Present work sheet for matching (choices distinctly different).
   2. Present work sheet with rows of forms (all of which are alike but one), and ask child to find the different one.
   3. Present work sheet with choices very similar, and requiring finer discrimination.*

Conclusion:

A. Repeat work sheets with which child had difficulty, ask him to trace each one, then make choice as he tells why it is different.

B. Teacher names each form as child selects from total group.

*Materials for each activity diminish in size from 2" to 1/2".

Lesson 11

Object: To develop the ability to discriminate between and to recognize object forms of animals, toys, and clothing.

Materials:
- A. Three large charts with solid black object forms of definite contour in large size (approximately 2").
  1. Animals such as: rabbits, cats, camels, horses, squirrels, cows, pigs, goats, giraffes, birds, roosters, etc.
  2. Toys such as: tricycles, trains, airplanes, wagons, boats, scooters, kites, dolls, etc.
  3. Clothing and accessories such as: trousers, mittens, gloves, umbrellas, glasses, etc.
- B. Individual cards with the same solid black object forms very similar in contour but in smaller size (approximately 1" to 1/4").

Procedure:
- A. Present large chart.
  1. Have child trace outline of object with finger--he names it if he can--if not he is told. Discuss shapes with appropriate descriptive words. such as round, square, pointed, large, small, etc.
  2. Teacher than names objects, and asks child to point to each one.
- B. Present child with individual cards containing object forms.
  1. Ask him to match to similar or like form on large chart.
  2. Ask child to look at small cards and name each object.
  3. Teacher then names objects, and asks child to pick out the one named from the small cards.

Conclusion:
- A. Review object names as to class.
- B. Ask child to find all object forms of one class.

3

Lesson 12

Object: To continue discrimination and recognition of object forms of household and related objects, fruits and vegetables, nature objects.

Materials:

A. Three large charts with solid black object forms of definite contour in large size (approximately 2").
   1. Household and related objects such as key, lamp, cup, milk bottle, table, etc.
   2. Fruits and vegetables such as apples, strawberries, carrots, beans, etc.
   3. Nature objects such as trees, leaves, flowers, etc.

Procedure: Same as Lesson 11.

Conclusion: Same as Lesson 11.

Lesson 13

Object: To develop the ability to discriminate and recognize outline drawings of objects with few inner details.

Materials:
- A. Large charts with selected object outlines in 1" and 2" sizes (same or similar to those presented in solid black in Lessons 11 and 12).
- B. Individual cards with outlines of same objects.

Procedure:
- A. Present large chart.
  1. Ask child to trace outlines with finger--check for recognition, review discriminating details, rounded, pointed, etc.
  2. Look at and trace individual parts of objects such as head, legs, handles, etc. as teacher and child discuss.
- B. Present child with small cards.
  1. Ask him to match to similar or like objects on larger chart.
  2. Mix cards, and ask child to name each one.
  3. Teacher then asks child to pick out certain ones as she calls the name of each.

Conclusion:
- A. Review object recognition as to class or to description.
- B. Child sorts cards as to object classes, such as all the fruits, vegetables, etc.

Lesson 14

Object: To develop the ability to further discriminate and recognize outline shapes of a wide variety of objects, and to recognize those same objects in colored pictures. Household objects, nature objects, and fruits and vegetables.

Materials:
- A. Large chart with outlined and colored objects in 1" and 2" sizes.
- B. Individual cards with outlines and colored pictures of the same objects (but not identical) in 1/4" to 1" sizes.
- C. Selected work sheets for discrimination of likenesses and differences and matching.

Procedure:
- A. Present large chart, and ask child to look at all pictures.
  - 1. Child names objects and colors he recognizes.
  - 2. Child traces unknown pictures, discusses shapes, colors, etc. as teacher calls attention to discriminating details.
- B. Present smaller individual cards, and ask child to match to same object on large chart.
- C. Present work sheets one at a time and discuss reason for choices with child.

Conclusion:
- A. Review objects by class--ask child to point to all the fruits, etc.
- B. Teacher names object and child selects correct one from cards.

Lesson 15

Object: To review discrimination and recognition of all black forms and line drawings of objects.

Materials:

A. Charts and forms used in previous lessons.
B. Work sheets containing pictures of same and like objects in different positions, and smaller in size. Match-Me game.

Procedure:

A. Present cards in flash for discrimination and recognition. Child responds by pointing to same object on larger chart as he calls name.
B. Game: Match Me.
   1. Child draws card, examines carefully, then continues drawing until he has found the match for each card.
   2. Teacher names object and child selects picture from group of five, then eight, then 12.

Conclusion:

A. Discuss with child discriminating details of objects.
B. Teacher describes object and asks child to select correct picture.

Lesson 16

Object: To teach likenesses and differences in inner details of similar objects. To observe recognized objects of varied sizes and positions. To teach left to right progression of observation (animals, toys, clothing, household objects, fruits and vegetables, nature objects).

Materials: Selected work sheets from readiness books containing object pictures.

Procedure:

A. Present child with one page at a time.
   1. Ask him to begin at left and inspect all pictures in the row and find the one that is different. Discuss ways in which it is different as child traces outline with finger.
   2. Note discriminating details of each. Ask him to note difference in position or in inner details.

Conclusion:

A. Discuss reasons for correct and incorrect responses.
B. Discuss likenesses and differences of objects in different positions.

Lesson 17

Object: To teach likeness of objects among many different ones--matching of like ones.

Materials: Selected work sheets from readiness books. Pages of objects--two in each box--some alike--some different.

Procedure:

A. Present sheets to child in order of progressing difficulty.
   1. Ask child to match picture with first one in row; discuss how others are different.
   2. Present pages of two objects--some alike in outline but different in inner detail--ask child to find those which are alike and those which are different. Discuss ways in which two objects differ.

Conclusion: Summarize ways of discriminating objects similar in contour and size.

Lesson 18

Object: To teach discrimination between two objects very similar in contour and/or position but like in nature. To teach matching of same picture among pictures very similar in contour and in nature (example: similarly shaped fruits, persons, etc.). To note missing parts of pictures.

Materials:

A. Pictures of boys, girls, animals, flowers, clothing, etc.
B. Work sheets of pictures of like objects with slight differences in inner details or in positions.
C. Pictures--some of which have missing parts.
D. Picture with missing object; choice of three or four missing objects.

Procedure:

A. Ask child to note sets of pictures which are alike, and those which are different. Discuss differences.
B. Present pictures--some of which have missing parts--ask child to note likenesses to companion picture, then to note any differences. Discuss differences he notes. (Example: pig, dog; boy, girl; chickens--running, pecking, standing; balls--one with stripes, one without; flowers--one with leaf or petal missing; scissors with handle missing; etc. boy with one skate, cap, shoe, ball, skate.)

Conclusion: Discuss differences in contour of persons or animals in different activities.

Lesson 19

Object: To teach discrimination and recognition of individual objects in colored pictures containing several objects and/or activities.

Materials:
- A. Farm scene with barn, farmer, and different animals.
- B. Picture with several people in various activities.
- C. Picture of city with various buildings, streets, cars.
- D. Circus scene with animals, clowns, performers.
- E. Zoo scene with animal cages, observers.
- F. Pet show scene with animals, toys, etc.

Procedure:
- A. Present each picture. Child observes each person, or other picture within. Discuss differentiating details, activities.
- B. Ask child to relate what he thinks is happening in the picture, and make up story as he makes observations.
- C. Note colors, size differences, positions. Child traces objects he is not able to recognize on sight noting details of form as he does so.

Conclusion: Summarize ways to discriminate singular elements among grouped objects and pictures.

Lesson 20

Object: To review ability to note differences and similarities in inner details, size and position, and activities in pictures.

Materials: Selected charts containing pictures similar to those which were most difficult to discriminate in previous lessons.

Procedure:

A. Ask child to observe picture--then discuss objects he recognizes.

B. Ask child to explain details he notes or which serve as clues to recognition. Assist child in use of most appropriate clues for rapid and accurate discriminations, assist him in use of appropriate descriptive terms.

Conclusion:

A. Review names and appropriate descriptive words of object details.

B. Encourage child to describe picture so that teacher can make correct choice; teacher describes and child makes choice.

Lesson 21

Object: To teach discrimination and recognition of relationships between objects of the same class. To understand ordering from large to small and vice versa.

Materials:

Work sheets from readiness books containing pictures of animals, toys, clothing, fruits, vegetables, and nature objects with two to four choices of related objects from which to choose the most suitable one. Example: cow, baby deer, calf, colt, cub.

Procedure:

A. Present charts or pages to child one at a time. Ask him to look at stimulus picture, name it, then choose the one that goes best with it.

B. Present child with page containing rows of objects of graduated sizes from large to small, then small to large for selection of the one that is out of place (2", 1 1/2", and 1" sizes).

Conclusion:

A. Review and practice left to right progression in observation.

B. Summarize progressive order of objects from largest to smallest or from smallest to largest.

Lesson 22

Object: To teach discrimination and recognition of relationships between objects of similar classification.

Materials:

A. Pictures and charts containing foods in same category except for one of different category (1" size).
B. Similar charts with other classes of objects.
C. Individual cards with pictures of same name (1" to 1/4" size).

Procedure:

A. Give child one page at a time, and ask him to name all the things he sees, then choose the one that does not belong in the picture.
B. Continue with other pages.
C. Game: Present child with group of cards containing objects of same class, but of different uses. Ask him to sort cards as to those which go together. Example: cards with clothing--outer, rain clothes, sleeping clothes, etc.; animals with same type fur, etc.

Conclusion:

A. Review different types of each class of objects presented.
B. Teacher shows picture of object and child gives type and class.

Lesson 23

Object: To teach finer discrimination of closely related objects in small pictures.

Materials:

A. Stimulus pictures with four or five related objects for choice of most closely related one.

B. Group pictures of objects all of which are similar except one which is different in kind or in a different position. Example: articles of clothing suitable for a boy and one suitable for a girl. Girl in party dress--choice of shoes most suitable. Pictures of animals of same name except for one (four cows plus one steer). (All pictures decrease in size from 2" to 1/2".)

Procedure:

A. Present child with work sheets. Explain the nature of the task then ask child to name each picture before he chooses the appropriate one.

B. Discuss reasons for his choice, and why other pictures are not suitable.

Conclusion:

A. Review appropriate descriptive terms as child observes picture.

B. Teacher describes objects and asks child to select picture for correct response.

Lesson 24

Object: To teach finer discrimination of objects of same name but different in style or position.

Materials: Four charts containing pictures of objects which all have the same name but are different in style, contour, or position: tables, balls, beds, trees, trucks, etc. (Diminishing sizes from 2" to 1/2".)

Procedure:

A. Present child with page of pictures. Ask him to note any likenesses of objects, note differences or likenesses of inner details, position, etc., give name, type and class if possible.
B. Ask child to describe differences between pictures assisting him in use of appropriate descriptive words as to type, class, position, and use.

Conclusion:

A. Review likenesses and differences among same objects.
B. Discuss appropriate descriptive words to designate individual types within same class.

Lesson 25

Object: To note and recognize missing parts or portions of object pictures.

Materials: Series of work sheets containing object pictures:

- A. Two objects--one whole--one with inner detail missing.
- B. Objects with missing parts--no whole object seen.
- C. Parts of objects--no whole object.
- D. Pictures of several objects one of which is missing from companion picture.

Procedure:

- A. Present chart 1--ask child to look at complete picture, then observe what is missing from the second picture.
- B. Present chart 2--ask child to look carefully at picture of object and find what part is missing.
- C. Present chart 3--child observes the object part, and determines the object to which it belongs.
- D. Present chart 4--child observes picture and names everything he sees in it--he then looks at companion picture, and determines the missing portion.

Conclusion:

- A. Review changes in contour resulting from missing parts.
- B. Teacher describes inner details of picture, and asks child to select correct picture.

Lesson 26

Object: To learn to organize visual details by putting parts of picture puzzle together.

Materials:

A. Large picture in color cut in four pieces.
B. Large picture in color cut in eight pieces.
C. Large picture in black and white cut in four pieces.
D. Smaller (5 x 7) colored picture in four pieces.
E. Smaller picture in black and white cut in four pieces.
F. Large picture in black and white cut in six pieces.

Procedure:

A. Present each child with puzzle pictures one at a time in the above order. Ask him to look at pieces and try to determine the nature of the picture. Then ask him to assemble the parts by matching colors, and lines.
B. Discuss content of picture, and tell a story about the picture.

Conclusion:

A. Review contour of shapes by discussing points, corners, lines, etc.
B. Ask child to take pictures of single objects, arrange in large picture and tell a story about it.

Lesson 27

Object: To understand a story by observation of picture sequence. To be able to arrange pictures to tell a story.

Materials: Six sets of small pictures (4 x 6 and 5 x 7) of three to ten pictures which tell a story.

Procedure:

A. Present child with set of pictures (three) of familiar rhymes such as "Jack and Jill" and "Little Miss Muffett." Ask him to look at each picture, then arrange in the order of events as he repeats the rhyme (4 x 6 in size).

B. Present child with set of four pictures which tell a story unknown to him. Child observes each picture and describes the happenings. Child arranges pictures so that story follows in logical order of events (4 x 6 in size).

C. Child is given set of eight pictures depicting story of "The Three Bears." Each picture is closely examined, then arranged in sequence so that the story can be told from the pictures (3 x 5 in size).

D. A set of smaller pictures (ten) are given child. The story is unknown. As the child observes the happening in each picture, teacher guides him in understanding the events in the story. The child then arranges the pictures as he relates the story (2 x 3 in size).

Conclusion:

A. Teacher selects individual pictures and asks child to tell the story related to the picture.

B. Teacher relates story as child arranges pictures accordingly.

Lesson 28

Object: To note likenesses and differences in words and single letters.

Materials:

A. Work sheets containing rows of pre-primer words.
B. Charts containing letters.
C. Work sheets with rows of letters for matching.

Procedure:

A. Child looks at each row of words and notes the one word that is different. Teacher guides child in observation of similarities of words as to length and configuration.
B. Child examines chart of letters. Teacher calls attention to similarities in contour, height, straight and curved portions.
C. Child is asked to match like letters, and to choose different ones in several pages of letters.

Conclusion:

A. Teacher presents word and asks child to describe in terms of length, configuration, etc.
B. Teacher describes word, and child selects one to fit the description.

Lesson 29

Object: To teach likenesses and differences in words and letters.

Materials: Work sheets containing:
- A. Like letters with one unlike letter to discriminate in each row.
- B. Like letters with one similarly shaped letter to discriminate.*
- C. Words with one unlike word to discriminate.
- D. Words with similar word to discriminate.
- E. Letters and words for matching.

Procedure:
- A. Present child with first page. Ask him to look at all the letters, and find the one that is different from the others. Repeat for next set.
- B. Give child sheet containing words. Ask him to look at all the words in each row, and select the one that is different from the others.
- C. Teacher displays one letter at a time, and child selects letter to match it from his page. Repeat for words.

Conclusion:
- A. Discuss likenesses in contour of similar letters and words, and help child to see distinguishing characteristics of each.
- B. Teacher describes letter in terms of points, corners, straight, and curved lines and child selects letter which meets the description.

*Letter size decreases from 1" block letters to sans serif large type with six letters per inch of space.

Lesson 30

Object: To review fine discrimination of small objects, missing parts, words, and letters.

Materials: Selected materials from Lessons 21-29.

Procedure:

A. Select charts which presented most difficulty, or which required finer discrimination and check to see if each child can make the necessary discriminations.

B. Game: Match-Me--picture cards with words. Child draws card and tries to match to partner's using both picture and word clues.

Conclusion:

A. Teacher describes fine details of object as child selects appropriate picture.

B. Child draws picture card and discusses distinguishing features by use of appropriate descriptive words.

Lesson 31

Object: To teach appropriate word symbols and word combinations for pictures.

Materials: Object pictures from previous lessons with word names; separate word cards (Dolch pre-primer word names).

Procedure:

A. Show picture and word to child. Ask child to name the object, then look carefully at the word.
B. Child selects word card which matches the word under the picture. (Use article words, connective words, and simple descriptive words with word names. Example: the boat, my ball, little boy, etc.) 3 x 5 pictures, words in 18 pt. type decreasing to 1 1/4 x 2 1/2 pictures in 10 pt. type.

Conclusion:

A. Teacher presents word card and child selects appropriate picture.
B. Teacher describes picture and asks child to select word card to match.

Lesson 32

Object: To teach additional word symbols and word combinations for pictures.

Materials:

A. Selected pictures of familiar objects on individual cards (2 1/2 x 4") with action and descriptive words. (Example: baby sleeping--sleep; boy running--run; large animal--big.)

B. Large chart depicting variety of actions (2" pictures).

C. Individual word cards (14 pt. type).

Procedure:

A. Child examines each picture on individual card and discusses what he sees as teacher identifies the word.

B. Child says word as he traces it and observes picture again.

C. Child discusses each picture on large chart as teacher guides in selection of descriptive word which child selects from three choices.

Conclusion:

A. Child draws word card and chooses picture which matches it.

B. Teacher describes action as child chooses picture and appropriate word.

Lesson 33

Object: To teach recognition of word symbols and word combinations. To recognize like letters and words in capital letters and in lower case letters.

Materials:

A. Object pictures from previous lessons.
B. Page containing words and phrases appropriate for pictures, (pre-primer and primer words from Dolch list).
C. Page containing letters in both capitals and lower case; words with first letter capitalized, and same words with all letters in lower case.

Procedure:

A. Child examines each picture and gives word name if possible; if not, teacher tells child the name.
B. Teacher presents page containing word names and words as combinations. Child looks at each word; he chooses picture which is most appropriate for the word or words giving reasons for his choice.
C. Teacher assists child in noting length of words as he says them and observes them, general configuration of words, and beginning and ending letters.

Conclusion:

A. Child selects all words beginning with same letter, then chooses picture to go with each word.
B. Teacher says phrases as child selects picture appropriate for each phrase, then selects phrases from the sheet.

Lesson 34

Object: To develop recognition of first grade word symbols and word combinations.

Materials:
- A. Selected pictures from Reading Readiness books with phrases and short sentences underneath.
- B. Identical phrases and short sentences on word cards (from felt pen manuscript of three letters per inch to large type of six letters per inch).

Procedure:
- A. Show child each picture, and ask him to discuss what he sees and what is happening in the picture.
- B. Teacher reads the phrase or sentence as the child observes carefully. Attention is called to the length of words, configuration, and beginning and ending letters.
- C. Individual slips are presented, and child is asked to match to the phrase or sentence under each picture.

Conclusion:
- A. Teacher assists child in reading each phrase or sentence as he observes the picture and the words.
- B. Teacher gives phrase or sentence verbally, and asks child to select the correct picture for response.

Lesson 35

Object: To develop speed and skill in sight recognition of words and phrases previously presented.

Materials:
A. Teacher-made picture cards and word cards for drill and games.
B. Match-Me reading game (Dolch picture cards with matching word cards).

Procedure:
A. Teacher exposes picture for one minute after which child selects appropriate word choice from five word cards (1/4" letters spaced four letters per inch made with felt pen).
B. Teacher exposes reading game pictures for 30 seconds, then asks child to select appropriate word from a choice of ten.

Conclusion:
A. Child with partner plays Match-Me Game by drawing picture cards, then word cards and matching as he does so.
B. Teacher says word, and child selects picture and word card for correct response.

Lesson 36

Object: To recognize pre-primer and primer words on sight, and to learn to combine them into meaningful phrases and sentences.

Materials: Pre-primer and primer word cards from 36 point type down to sans serif large typewriter type spaced at six letters per inch.

Procedure:

A. Present child with ten word cards in the largest type. Ask child to read each word, then build meaningful phrases and sentences using from three to six words.

B. Repeat this procedure with the same words in diminishing type size until the child can continue to recognize all words. For any problem words, teacher assists child in noting length, configuration, beginning and ending letters.

Conclusion:

A. Teacher builds phrases and sentences and asks child to read them.

B. Teacher gives phrases and sentences verbally and asks child to select word cards.

Lesson 37

Object: To strengthen sight recognition of first grade words in combination.

Materials: First grade words (Dolch list) from 36 point type down to sans serif large typewriter type spaced at six letters per inch.

Procedure: Same as Lesson 36.

Conclusion: Same as Lesson 36.

Lesson 38

Object: To confirm sight recognition of pre-primer, primer, and first grade words, and to read simple sentences.

Materials:
A. Prepared charts of short sentences using words from the Dolch list for primary readers (letters 1/2" high spaced four letters per inch, and made with black felt pen).
B. Selected pages from Reading Readiness books containing short sentences printed in primary type ordinarily found in readiness books.

Procedure:
A. Present child with teacher-prepared charts, and ask him to read sentences as teacher gives guidance and assistance in word recognition techniques as needed.
B. Repeat A with printed pages presented one at a time.

Conclusion:
A. Teacher gives sentence orally and asks child to select correct response from chart or page.
B. Teacher asks child to read the sentence about: the dog; the boy; the baby, etc.

Lesson 39

Object: To practice reading simple material for pleasure.

Materials:

A. Teacher-pupil original stories on charts (in 1/2" size letters spaced four letters to the inch and prepared with felt point pen).

B. Pre-primer story or specially prepared story in large typewriter type spaced six letters per inch).

Procedure: Child is asked to read story on chart or page as teacher listens, and gives assistance in word recognition clues for new or unknown words.

Conclusion:

A. Child is asked to relate stories she has read as teacher gives assistance in sequence and use of words.

B. Teacher asks questions regarding stories, and child responds by correct answer and the story from which he read it.

Lesson 40

Object: To increase speed of recognition on short exposure of pre-primer, primer, and first grade words.

Materials:

A. Dolch Word Game.

B. Teacher prepared cards of single words, phrases, and short sentences containing problem words.

Procedure:

A. Word drill of Dolch's basic sight vocabulary for pre-primer, primer, and first grade words (primary size type). Teacher exposes word card for five seconds, if child is unable to recognize, word is laid aside.

B. Present unrecognized words for longer period. If child still cannot recognize, tell him word and point out clues for sight recognition.

Conclusion: Game: Teacher exposes word card to each partner, allows ten seconds and scores point if child can recognize. Continue with all words until winner is declared.

The following lessons are presented as samples of the individualized lessons planned for those children who progressed beyond the planned sequence of 40 lessons.

Lesson 41

Object: To increase sight vocabulary of primer, first, second, and third grade level primary words by special learning techniques.

Materials:

A. Mills Learning Test (manuscript letters 1/4" high made with No. 2 lettering pen spaced at five letters per inch on individual cards with and without pictures).
B. Identical words on one sheet in large typewriter type spaced at six words per inch.

Procedure:

A. Present primer words in Mills Test with picture side. Ask child to look at picture, and then at the word. The child traces the word as he and the teacher pronounce it. (Present ten words at a time.)
B. Teacher exposes word without picture for ten seconds, and asks child to say the word.
C. Repeat the above procedure for as many as 40 words if indicated by individual progress.

Conclusion:

A. Teacher selects unrecognized words, and reviews with child as he observes picture, traces the word, and pronounces it.
B. Review difficult words without picture to reinforce learning.

Lesson 42

Object: To strengthen basic sight vocabulary by use of Dolch's Popper Words, Set 1, and to encourage speed in sight recognition.

Materials:
- A. Dolch's Popper Words, Set 1 (14 point type).
- B. Identical words in large typewriter sans serif type spaced at six letters per inch.

Procedure:
- A. Present words one at a time. Teacher says the word with the child as he traces it. Note general configuration, and beginning and ending letters.
- B. Repeat the procedure for those words which give difficulty.
- C. Expose words for five seconds to strengthen speed of recognition.

Conclusion:
- A. Ask child to build sentences with word cards, and read them.
- B. Present words on one sheet in large typewriter type, and ask child to read as many as possible.

Lesson 43

Object: To develop the ability to read phrases and short sentences at first grade level.

Materials:
- A. Pages from selected work books containing pictures plus appropriate phrases and sentences.
- B. Prepared sentences in large typewriter type.

Procedure:
- A. Ask the child to observe all the pictures on the page, and to name the object or the action. Child then chooses the appropriate phrase for each picture and reads it.
- B. Repeat A for pages containing short sentences.

Conclusion:
- A. Present child with groups of sentences prepared by teacher, and ask him to read them.
- B. Review configuration and other sight recognition cues for words which child finds difficult.

Lesson 44

Object: To introduce low vocabulary, high interest reading material at first grade level.

Materials: Chandler, Edna W. Cowboy Sam. Chicago: Beckley-Cordy Co.

Procedure:
- A. Present child with the book. Discuss the picture clues and the general background of the story.
- B. Child reads story as teacher assists with recognition techniques and basic word attack skills as necessary.
- C. Teacher takes note of types of errors and any problems in visual discrimination of words and letters within words.

MATERIALS USED IN VISUAL STIMULATION PROGRAM

Bulletin-board charts for first grade. Dansville, N. Y.: F. A. Owen Pub. Co., 1946.

Chandler, Edna W. Cowboy Sam. Chicago: Beckley-Cardy Co., 1951.

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Craig, G. S. & Daniel, Etheleen. Science Around You. N. Y.: Ginn & Co., 1960, A. P. H., 1960.

Dolch, E. W. Picture Word Cards. Champaign, Illinois: The Garrard Press.

Dolch, E. W. Popper Words--Set 1 (easier half basic sight vocabulary). Champaign, Ill.: The Garrard Press, 1960.

Dolch, E. W. Popper Words--Set 2 (harder half basic sight vocabulary). Champaign, Ill.: The Garrard Press, 1960.

Dowling, T. I., Freeman, K., Lacy, Nan, & Tippett, J. S. I Wonder Why. Chicago: John C. Winston Co., 1951. Large type edition.

Fahy, Louise G. My First Reading Unit, Part 2. Brookfield, Ill.: Gel-Stern Supply Co., Inc.

Hardy, Marjorie. Surprise Stories, First Reader. Upper Montclair, N. J.: Clear Type Publishing Committee.

Harris Lateral Dominance Kit.

Lewis, W. D., Rowland, A. L., & Gehres, Ethel H. The Silent Readers, Second reader. Cleveland: Clear Type Publishing Committee, 1926.

Mills, R. E. Learning Methods Test. Ft. Lauderdale, Fla.: Mills Center, Inc., 1955.

Oftedal, Laura, & Jacob, Nina. My First Dictionary. New York: Grossett and Dunlap.

Pre-primer Words--Flash Cards. St. Louis, Mo.: The Gelles-Widmer Co., 1959.

Sanders, Ardis. Match-Me (a reading readiness game). Fowler, Ind.: Benton Review Publishing Co., Inc., 1962.

Smith, Gale. The Game of Match Word (a reading game). Fowler, Ind.: Benton Review Publishing Co., Inc., 1954.

Assorted Reading Readiness Books.

Individual Cards, 2 x 3; 2 1/2 x 4; 3 x 5.

Felt tip pens.

Montessori-type wooden peg sets of natural color in following sizes:
- Set 1. 8 pegs--all 3" tall.
  Diameters: 3", 2 1/2", 2", 1 1/2", 1", 3/4", 1/2", 3/16".
- Set 2. 8 pegs--all 1" diameter.
  Heights: 4", 3 1/2", 3", 2 1/2", 2 1/4", 2", 1 3/4", 1 1/2".
- Set 3. 8 pegs
  1. 4" height - 4" diameter
  2. 3 3/4" height - 3 1/2" diameter
  3. 3 1/2" height - 3" diameter
  4. 3 1/4" height - 2 1/2" diameter
  5. 3" height - 2" diameter
  6. 2 3/4" height - 1 1/2" diameter
  7. 2 1/2" height - 1" diameter
  8. 2 1/4" height - 3/4" diameter
- Peg boards: 4" wide; 1 1/2" space at each end; 1" between pegs.

Six sets of wooden color strips: red, blue, yellow, green, orange, and purple in the following dimensions:
- 1" wide; 3/8" thick
- Each set 8 in diminishing lengths: 6", 6 1/2", 5", 4 1/2", 4", 3 1/2", 3", 2 1/2".
- 6 sets of strips in these colors: red, blue, yellow, green, orange, purple.

APPENDIX B

Rating Sheet for Daily Progress

Daily Progress Percentage Scores for Individuals

Summaries of Individual Subjects in Experimental Group

RATING SHEET FOR DAILY PROGRESS

Score_____ 1. Traces with finger the outline of material presented to indicate he sees it.

_____ 2. Discriminates likenesses in materials presented.

_____ 3. Discriminates differences in materials presented.

_____ 4. Discriminates inner details in single pictures, single pictures in group, or letters in words.

_____ 5. Recognizes materials presented by name.

_____ 6. Sees a Gestalt with object visible.

_____ 7. Sees a Gestalt without object visible.

_____ 8. Communicates understanding of instructions and material presented.

Scoring: 3 S is able to perform after instructions

2 S performs with instruction plus assistance

1 S performs with instruction plus constant assistance and/or supervision

0 S is unable to perform

A score of 12 indicates that the S is ready to progress to the next lesson.

A score between 8 and 12 indicates a need for review before progressing to the next lesson.

A score of below 8 indicates a need to repeat the lesson in entirety.

If a S is unable to attain a score of 8 or more by five repetitions of the same lesson, the next lesson will be presented.

Table 11

Daily Progress Percentage Scores for Individuals

Subject	Total Lessons Completed	Highest Possible Mean Score	Acquired Mean Score	Average Percentage
01	56	19.07	16.70	88
02	56	19.07	15.80	83
03	38	18.80	13.40	71
04	43	18.90	13.00	69
05	36	18.66	13.66	73
06	41	18.88	13.80	73
07	35	18.60	11.00	59
08	29	18.60	11.80	63
09	36	18.66	12.90	69
10	34	18.50	11.62	63

SUMMARIES OF INDIVIDUAL SUBJECTS IN EXPERIMENTAL GROUP

Subject Number 1

Sex: Male
Age: 9-6
Grade Placement: 4
Interim-Hayes-Binet IQ: 108
Distance Visual Acuity:
OD -- OS 5/200
Harris Lateral Dominance:
Hand Dominance: R
Eye Condition:
Eye Dominance: L
RLF - Myopia
Foot Dominance: R

Quantitative Scores	Pretest	Posttest
Visual Discrimination Test	53.0	56.0
Near Vision Acuity	OD -- OS 4/140	OD -- OS 5/140
Gates Word Recognition	2.35	2.78
Gates Sentence Reading	2.17	2.17
Gates Paragraph Reading	--	2.35

Number of lessons completed: 56

Average percentage of daily scores: 88%

Observational data:

This boy exhibited evidence of having been endeavoring to see, and had already acquired some visual efficiency in making discriminations and recognitions. His inattention to finer details was obvious, and he had some difficulty with figure ground relationships. He was able to recognize many words and could read even small print on a second grade level. He indicated a slight general weakness in appropriate vocabulary for descriptions, and communication of visual discriminations. His eagerness led him to premature closure on many recognitions, but was able to make most of his own corrections by closer observations.

The boy showed no understanding of basic word attack skills with which to recognize new words he encountered--he simply spelled them out. He progressed in his ability to note finer details, and to recognize almost all words on sight. He was soon reading regular size print in second grade books for short periods of time. He read slowly and miscalled a few words, but was not deterred by this, but appeared fascinated by his own achievements.

He stated that his parents had helped him some with print reading after he had learned to read braille. His teachers had allowed him to look at print books if he asked for them, but had given him no assistance in reading print.

Subject Number 2

Sex: Male
Age: 10-0
Grade Placement: 3
Interim-Hayes-Binet IQ: 103
Distance Vision Acuity:
OD 6/200 OS 3/200
Harris Lateral Dominance:
Hand Dominance: R
Eye Dominance: L
Eye Condition:
RLF
Foot Dominance: R

Quantitative Scores	Pretest	Posttest
Visual Discrimination Test	53.0	57.5
Near Vision Acuity	OD 5/140 OS 6/140	OD CF 10" OS 3/140
Gates Word Recognition	1.80	2.10
Gates Sentence Reading	--	2.13
Gates Paragraph Reading	--	2.20

Number of lessons completed: 56

Average percentage of daily scores: 83%

Observational data:

With a bubbling personality and an enchanting smile, this lad had a tendency to be inattentive, was unable to follow through with instructions for any length of time, and exhibited a general attitude of defeat in every new challenge. Very shortly he showed tremendous improvement in work habits, patience to continue with difficult activities, and in general attitude. Apparently, he was motivated by the maturity and seriousness with which his partner worked, and was able to gain a higher degree of self-confidence in his own abilities.

By the third week this youngster arrived early, and was happy and eager to "see new things." His desire and actual need for praise and constant reinforcement decreased gradually as he became aware of his newly acquired visual skills.

He exhibited a strong background in reading readiness activities, and his expressive vocabulary was superior to that of any other child. He seemed always to be competing with himself, and progressed to the primary reading level quite rapidly. He had no word recognition techniques except to spell each word, but was able to learn clues and basic word attack skills faster than his partner. After his ability became evident to him he required less and less support, and insisted that no help be given him in word recognition unless he requested it.

Although this boy had good residual sight in each eye; he was unable to use his vision binocularly (a fact confirmed by consulting the ophthalmologist). He shifted his work so as to alternate the use of his eyes, but appeared to use the left eye the majority of the time.

As soon as he was presented with reading material in story form, his enthusiasm indicated an insatiable desire for additional speed and skill, which caused him to make remarkable progress. His Gates Reading grade levels confirmed in rapid progress.

By the close of the experiment he displayed strong confidence in his ability, and had developed very acceptable work habits. This boy had decided himself that he would be able to do some of his future school work with visual materials, a suggestion which the investigator felt was very realistic for him.

Subject Number 3

Sex: Male	Age: 11-4
Grade Placement: 3	Interim-Hayes-Binet IQ 81
Distance Vision Acuity:	Harris Lateral Dominance:
OD Obj. P. OS Obj. P.	Hand Dominance: M
Eye Condition:	Eye Dominance: L
RLF	Foot Dominance: M

Quantitative Scores	Pretest	Posttest
Visual Discrimination Test	48.0	56.0
Near Vision Acuity	OD LP OS 1/200 (Snellen)	OD 1/200 (Snellen) OS CF 10"
Gates Word Recognition	--	1.7

Number of lessons completed: 38

Average percentage of daily scores: 71%

Observational data:

With a very quiet, but cooperative attitude, this boy found it necessary to exert effort for all visual observations. He worked diligently from the beginning by use of trial and error methods, and correcting most of his own inaccuracies.

Although this child appeared to make accurate discriminations, he exhibited few recognition techniques, and had a noticeable deficit in making associations with tactually known objects. The appearance of objects in different positions or contour, and his general communicative vocabulary revealed a restriction in background experiences.

As he progressed in recognition abilities he continuously asked for (and was supplied with) visual materials to examine outside the lesson period. His patience and perseverance enabled him to compensate to a marked degree for his lack of alertness and proficiency in memory.

Word recognition techniques continued to prove difficult for him, and he was unable to make extensive progress in this skill. He did, however, acquire sufficient recognition clues to enable him to score at the 1.7 grade level on the Gates Word Recognition Test.

Subject Number 4

Sex: Female   Age: 8-1

Grade Placement: 2   Interim-Hayes-Binet IQ: 93

Distance Vision Acuity:	Harris Lateral Dominance:
OD Obj. P. OS 3/200	Hand Dominance: R
Eye Condition:	Eye Dominance: L
Congenital Cataracts - Nystagmus	Foot Dominance: R

Quantitative Scores	Pretest	Posttest
Visual Discrimination Test	40.5	53.5
Near Vision Acuity	OD MO OS 1/200 (Snellen)	OD MO OS 4/140
Gates Word Recognition	--	2.0
Gates Paragraph Reading	--	1.5

Number of lessons completed: 43

Average percentage of daily scores: 69%

Observational data:

At first, this girl required repeated instructions, continuous verbal assistance, and strong reinforcement. She worked slowly and deliberately by trial and error methods. She showed a paucity in her general experience knowledge, and in her understanding of expressive communication.

The interest of this child continued at a high level, and she was quite able to discriminate clearly, even to small details. Continued tracing of observations, plus encouragement and confidence in her own abilities, permitted her to maintain a steady rate of progress.

Although she recognized only a few of the letters in print, she was fascinated by letters and words to learn visually. Her progress from this point surpassed all expectations, and by the conclusion of the experimental period, she was reading 18 point type near the second grade level. An unsolicited remark by her teacher revealed that her class participation and school work had shown a real spurt also.

Subject Number 5

Sex: Female	Age: 8-1
Grade Placement: 1	Interim-Hayes-Binet IQ 100
Distance Vision Acuity:	Harris Lateral Dominance:
OD Obj. P. OS 2/200	Hand Dominance: M
Eye Condition:	Eye Dominance: L
RLF - Nystagmus	Foot Dominance: L

Quantitative Scores	Pretest	Posttest
Visual Discrimination Test	39.0	44.5
Near Vision Acuity	OD MO OS 4/140	OD MO OS 5/140

Number of lessons completed: 36

Average percentage of daily scores: 73%

Observational data:

Visual abilities of this little girl were observable from the beginning. She was able to see all materials presented with ease and recognized readily all things with which she was acquainted. Her progress was steady in the first few weeks, but she encountered some difficulty when association and relation to other materials was required.

This child was able to recognize very few print letters and appeared to have problems in immediate memory and recall. By the completion of the experiment she was able to recognize a few words on sight in any size type (down to J 10), but she continued to experience real difficulty in all activities requiring memory.

Subject Number 6

Sex: Male	Age: 11-4
Grade Placement: 5	Interim-Hayes-Binet IQ: 105

Distance Vision Acuity:

OD 2/200 OS --

Eye Condition:

Bilateral glaucoma
Sublaxations lens

Harris Lateral Dominance:

Hand Dominance: M

Eye Dominance: R

Foot Dominance: M

Quantitative Scores	Pretest	Posttest
Visual Discrmination Test	37.0	52.0
Near Vision Acuity	OD 6/140 OS --	OD 2/200 (Snellen) OS --

Number of lessons completed: 41

Average percentage of daily scores: 73%

Observational data:

The first activities presented to this boy were appealing, and met with general enthusiasm. He had no problems with black forms and outline shapes, and he exhibited a high level of understanding of instructions. Colors were confusing to him, and his performances gave every indication that he was "color blind."

His interest and motivation varied from day to day, and at times he exhibited an attitude of resistance to "learning to see." As his progress continued, this attitude became more noticeable. He finally revealed that he didn't want to learn to see too well, "because the teacher might try to get him to read print, and he didn't want to." Apparently, he felt secure in his braille medium, and was unwilling to exert himself to the extent of learning a new medium, even to enrich his education.

With constant reinforcement and praise, he demonstrated his ability to recognize almost any visual materials so long as they were not too detailed or smaller than 24 point type. Despite the fact that he made unusual progress, the investigator never felt that he had done his best or had achieved his optimal ability.

Subject Number 7

Sex: Female	Age: 7-9
Grade Placement: 1	Interim-Hayes-Binet IQ: 83
Distance Vision Acuity:	Harris Lateral Dominance:
OD -- OS LP	Hand Dominance: M
Eye Condition:	Eye Dominance: L
Bilateral congenital cataracts	Foot Dominance: L

Quantitative Scores	Pretest	Posttest
Visual Discrimination Test	30.5	43.0
Near Vision Acuity	OD -- OS LP	OD -- OS CF 14"

Number of lessons completed: 35

Average percentage of daily scores: 59%

Observational data:

This little girl displayed an eagerness for new experiences and activities, and sought much support and reinforcement from the first. Her attention span was extremely short, and despite considerable progress, her lack of training in self-control and responsibility appeared to retard her ability to reach her maximum functioning potential.

She displayed no difficulty in making discriminations of any size, although her deprived background was detrimental to her recognition ability. She was always full of questions about all materials and activities, and displayed very positive learning potential by her immediate memory and delayed recall of earlier visual experiences.

The experimental time was insufficient to enable her to compensate for her complete lack of readiness for presentation of letter and word symbols. There appeared to be no doubt that she was able to use her residual vision for educational enhancement, but that her progress would continue to be rather slow until she was able to fill in some of the missing links in her readiness background.

Subject Number 8

Sex: Male

Grade Placement: 5

Distance Vision Acuity:

OD LP OS CF 1"

Eye Condition:

Optic Atrophy

Age: 12-6

Interim-Hayes-Binet IQ 104

Harris Lateral Dominance:

Hand Dominance: R

Eye Dominance: R

Foot Dominance: R

Quantitative Scores	Pretest	Posttest
Visual Discrimination Test	25.0	24.0
Near Vision Acuity	OD LP OS LP	OD CF 3" OS 2/140

Number of lessons completed: 29

Average percentage of daily score: 63%

Observational data:

This boy appeared to find it extremely difficult to acquire a visual image. Patient and determined effort made it possible for him to learn to make visual discriminations. His excellent memory and ability to relate past observations to present activities enabled him to make many meaningful recognitions.

It was necessary for him to hold all materials almost against his eye. His potential ability to make use of visual materials remained questionable throughout the experimental program, and he gave every indication of actually being unable to see the materials clearly.

Subject Number 9

Sex: Female

Grade Placement: 3

Age: 11-5

Interim-Hayes-Binet IQ 87

Distance Vision Acuity:

OD 4/200 OS 2/200

Eye Condition:

Bilateral Cataracts

Harris Lateral Dominance:

Hand Dominance: R

Eye Dominance: R

Foot Dominance: M

Quantitative Scores	Pretest	Posttest
Visual Discrimination Test	21.0	42.5
Near Vision Acuity	OD 2/140 OS 2/140	OD 5/140 OU 3/140
Gates Word Recognition	--	1.7

Number of lessons completed: 36

Average percentage of daily scores: 69%

Observational data:

Obviously pleased with individual attention, this girl required constant supervision and reinforcement in order to exert any effort to perform the activities presented. Her whole manner suggested extreme immaturity and lack of motivation. As the investigator continued to support and encourage her she began to progress in self-confidence. Her enjoyment of successes gave her sporadic motivation, although she continued to be "lazy" throughout the entire program.

She was able to make visual discriminations quite easily, but her deprived experiential background and undeveloped memory patterns appeared to hamper her ability to recognize what she was seeing.

Increased self-motivation was evident with the introduction of letter and word symbols, and her progress was unusual for the remainder of the program. She began to read words and simple material with apparent ease, and the investigator felt that she was capable of making excellent use of her vision for supplementary reading and other activities provided she could develop a real desire to do so. A long period of training and strong motivation would probably be required for her to succeed in the use of visual materials.

Subject Number 10

Sex: Male

Age: 8-6

Grade Placement: 1

Interim-Hayes-Binet IQ: 88

Distance Vision Acuity:

OD -- OS Obj. P.

Harris Lateral Dominance:

Hand Dominance: M

Eye Dominance: L

Foot Dominance: M

Eye Condition:

RLF

Quantitative Scores	Pretest	Posttest
Visual Discrimination Test	17.5	36.0
Near Vision Acuity	OD -- OS CF 14"	OD -- OS CF 14"

Number of lessons completed: 34

Average percentage of daily scores: 63%

Observational data:

Difficulty in understanding and following instructions presented a major problem from the very beginning. This boy appeared to "forget" what he was attempting to do. With constant supervision, verbal assistance and reinforcement, he was able to make all discriminations. So long as he was questioned and assisted he recognized most of the materials. There was an obvious lack of memory recall from day to day so that his progress was intermittent.

His major problem appeared to be in perceptual organization rather than an inability to acquire visual impressions. His pleasant attitude permitted the necessary drill and repetition for him to achieve some successes. The potential for learning by use of any media remained questionable throughout the program. However, his gain in test score was indication that some learning in visual activities had taken place.

APPENDIX C

Analysis of Item Pool

Analysis of Pretest Scores for Internal Consistency Reliability

Analysis of Pretest Scores for Split-half Reliability

Analysis of Test-retest Scores for Control and Print Comparison (Criterion) Groups

Identifying Characteristics of Experimental Group

Identifying Characteristics of Control Group

Identifying Characteristics of Print Comparison (Criterion) Group

Table 12

Analysis of Item Pool

Item No.	Rank Order	W_L	W_H	W_L-W_H	W_L+W_H	Item No.	Rank Order	W_L	W_H	W_L-W_H	W_L+W_H
33	1	11	14	-3	25	101	41	14	10	4	24
16	2	9	10	-1	19	102	42	13	9	4	22
91	3	12	13	-1	25	2	43	6	1	5	7
99	4	12	13	-1	25	3	44	12	7	5	19
5	5	7	7	0	14	14	45	9	4	5	13
26	6	9	9	0	18	29	46	11	6	5	17
44	7	3	2	1	5	31	47	5	0	5	5
95	8	9	8	1	17	34	48	11	6	5	17
98	9	11	10	1	21	36	49	6	1	5	7
1	10	2	0	2	2	38	50	5	0	5	5
7	11	2	0	2	2	49	51	5	0	5	5
13	12	10	8	2	18	61	52	9	4	5	13
15	13	9	7	2	16	71	53	5	0	5	5
23	14	2	0	2	2	90	54	13	8	5	21
27	15	2	0	2	2	92	55	14	9	5	23
28	16	13	11	2	24	104	56	14	9	5	23
37	17	6	4	2	10	8	57	6	0	6	6
48	18	2	0	2	2	10	58	7	1	6	8
74	19	9	7	2	16	17	59	6	0	6	6
94	20	12	10	2	22	30	60	8	2	6	10
18	21	4	1	3	5	32	61	6	0	6	6
20	22	3	0	3	3	40	62	7	1	6	8
21	23	3	0	3	3	41	63	6	0	6	6
24	24	4	1	3	5	52	64	8	2	6	10
42	25	3	0	3	3	53	65	9	3	6	12
50	26	3	0	3	3	54	66	9	3	6	12
56	27	73	10	3	23	55	67	11	5	6	16
63	28	11	8	3	19	60	68	6	0	6	6
88	29	15	12	3	27	65	69	10	4	6	14
93	30	11	8	3	19	67	70	7	1	6	8
96	31	13	10	3	23	68	71	6	0	6	6
100	32	12	9	3	21	70	72	8	2	6	10
6	33	4	0	4	4	73	73	7	1	6	8
12	34	4	0	4	4	75	74	12	6	6	18
35	35	8	4	4	12	76	75	6	0	6	6
46	36	5	1	4	6	80	76	10	4	6	14
51	37	10	6	4	16	89	77	10	4	6	14
59	38	4	0	4	4	103	78	14	8	6	22
78	39	8	4	4	12	4	79	11	4	7	15
97	40	11	7	4	18	9	80	10	3	7	13

Analysis of Item Pool (Continued)

Item No.	Rank Order	W_L	W_H	$W_L - W_H$	$W_L + W_H$	Item No.	Rank Order	W_L	W_H	$W_L - W_H$	$W_L + W_H$
19	81	7	0	7	7	83	94	10	2	8	12
22	82	7	0	7	7	86	95	12	4	8	16
39	83	7	0	7	7	105	96	14	6	8	20
47	84	7	0	7	7	77	97	11	2	9	13
58	85	7	0	7	7	79	98	11	2	9	13
62	86	11	4	7	15	85	99	15	6	9	21
69	87	7	0	7	7	25	100	12	2	10	14
72	88	8	1	7	9	45	101	10	0	10	10
84	89	13	6	7	19	57	102	11	1	10	12
87	90	11	4	7	15	64	103	10	0	10	10
11	91	8	0	8	8	82	104	12	2	10	14
43	92	10	2	8	12	81	105	13	2	11	15
66	93	11	3	8	14						

The procedure for this item analysis may be found in Ross and Stanley, (1954, p. 447-451).

Approximately 30% of the low scorers papers and 30% of the high scorers papers were used for this analysis. In the table, W_L refers to the number of the low scorers who missed each item. The number of high scorers who missed each item is found under W_H. $W_L - W_H$ gives the discrimination power of the item.

On the basis of 60 papers of approximately 100 items, the critical minimum significant discriminating power ($W_L - W_H$) was found by consulting the appropriate table. For this analysis a value of five was found to have the critical minimum discriminating power.

The difficulty level of items was determined through the use of the $W_L + W_H$ column by the following formula:

$$\frac{100 \times O}{2n\ (O - 1)}\ W_L + W_H = \text{difficulty level}$$

Table 13

Analysis of Pretest Scores for Internal Consistency Reliability

Pretest Scores of Experimental and Control Groups	Percent Passing and Failing Each Item on Pretest							
	Item No.	%P	%Q	PQ	Item No.	%P	%Q	PQ
54.0	1	.84	.16	.134	29	.60	.40	.240
54.0	2	.64	.36	.230	30	.48	.52	.250
53.0	3	.48	.52	.250	31	.64	.36	.230
53.0	4	.64	.36	.230	32	.48	.52	.250
51.0	5	.52	.48	.250	33	.60	.40	.240
48.0	6	.64	.36	.230	34	.48	.52	.250
47.0	7	.72	.28	.202	35	.72	.28	.202
44.0	8	.72	.28	.202	36	.72	.28	.202
42.0	9	.72	.28	.202	37	.84	.16	.134
41.0	10	.68	.32	.218	38	.72	.28	.202
40.5	11	.72	.28	.202	39	.56	.44	.246
39.0	12	.52	.48	.250	40	.72	.28	.202
37.0	13	.24	.76	.182	41	.72	.28	.202
30.5	14	.56	.44	.246	42	.72	.28	.202
27.0	15	.72	.28	.202	43	.64	.36	.230
27.0	16	.60	.40	.240	44	.52	.48	.250
25.0	17	.88	.12	.106	45	.64	.36	.230
21.0	18	.84	.16	.134	46	.56	.44	.246
17.5	19	.72	.28	.202	47	.72	.28	.202
17.0	20	.52	.48	.250	48	.44	.56	.246
17.0	21	.56	.44	.246	49	.60	.40	.240
13.0	22	.80	.20	.160	50	.36	.64	.230
10.0	23	.88	.12	.106	51	.36	.64	.230
10.0	24	.52	.48	.250	52	.12	.88	.106
	25	.72	.28	.202	53	.24	.76	.182
	26	.48	.52	.250	54	.28	.72	.202
	27	.44	.56	.246	55	.44	.56	.246
	28	.72	.28	.202	56	.44	.56	.246

Kuder-Richardson formula: $r_{11} = \left(\frac{n}{n - 1}\right)\left(\frac{SD_t^2 - EPQ}{SD_t^2}\right)$

$$r_{11} = .963$$

Internal Consistency Reliability Coefficient = .96

Table 14

Analysis of Pretest Scores for Split-half Reliability

Pretest Scores of Experimental and Control Groups			
Odd Scores		Even Scores	
X	X	Y	Y
28.0	26.0	26.0	22.0
23.0	26.0	24.0	27.0
26.0	28.0	25.0	26.0
23.0	24.0	21.0	16.5
20.0	18.0	19.0	21.0
22.0	19.0	18.0	18.0
14.0	17.0	13.0	13.5
8.0	12.0	9.0	13.0
8.0	11.0	5.0	10.0
5.0	9.0	5.0	8.5
5.0	16.0	5.0	11.0
25.0	9.0	28.0	8.0

Mean X = 17.76

$SD_X = 7.55$

Mean Y = 16.54

$SD_Y = 7.50$

$$r = \frac{NEXY - (EX)(EY)}{\sqrt{\left\{\left[NEX^2 - (EX)^2\right]\left[NEY^2 - (EY)^2\right]\right\}}}$$

r = .946

Spearman-Brown Correction

$$r = \frac{2(r)}{1 + r}$$

Split-half Reliability Coefficient = .97

Table 15

Analysis of Test-retest Scores for Control and Print Comparison (Criterion) Groups

Test 1 X	Both Groups X	Test 2 Y	Both Groups Y
56.5	44.0	57.5	48.5
56.0	44.0	57.0	48.5
54.5	43.0	55.5	48.5
54.0	42.0	55.0	46.5
54.0	41.0	55.0	44.0
53.0	33.0	55.0	38.0
51.5	27.0	54.5	24.5
51.0	27.0	54.5	19.0
51.0	17.0	51.0	17.0
47.0	13.0	51.0	13.0

Mean X = 42.975

$SD_X = 13.05$

Mean Y = 44.775

$SD_Y = 14.09$

$r = .977$

Spearman-Brown Correction

$$r = \frac{2(r)}{1 + r}$$

$r = .98$

Test-retest Stability Coefficient = .98

Table 16

Identifying Characteristics of Experimental Group

Subject	Sex	CA (in mos.)	MA (in mos.)	Grade Placement	Distance Acuity	Near Acuity		Discrimination Test Scores		Gates Reading Grade					
										Pre			Post		
						Pre	Post	Pre	Post	WR	SR	PR	WR	SR	PR
1	M	115	124	4	OD -- OS 5/200	OD -- OS 4/140	OD -- OS 5/140	53.0	56.0	2.35	2.17	--	2.78	2.17	2.35
2	M	120	124	3	OD 6/200 OS 3/200	OD 5/140 OS 6/140	OD CF 10" OS 3/140	53.0	57.5	2.1	--	--	2.11	2.13	2.2
3	M	136	110	3	OU Obj.P.	OD LP OS 1/200	OD 1/200 OS CF 10"	48.0	56.0	--	--	--	1.17	--	--
4	F	121	113	2	OD Obj.P.(Snellen) OS 3/200	OD MO OS 1/200	OD MO OS 4/140	40.5	53.5	--	--	--	2.0	1.5	--
5	F	97	97	1	OD Obj.P.(Snellen) OS 2/200	OD MO OS 4/140	OD MO OS 5/140	39.0	44.5	--	--	--	--	--	--
6	M	136	143	5	OD 2/200 OS --	OD 6/140 OS --	OD 2/200 (Snellen) OS --	37.0	52.0	--	--	--	--	--	--
7	F	93	76	1	OD -- OS LP	OD -- OS CF 10"	OD -- OS CF 14"	30.5	43.0	--	--	--	--	--	--

Identifying Characteristics of Experimental Group (Continued)

Sub-ject	Sex	CA (in mos.)	MA (in mos.)	Grade Place-ment	Distance Acuity	Near Acuity		Discrim-ination Test Scores		Gates Reading Grade					
										Pre			Post		
						Pre	Post	Pre	Post	WR	SR	PR	WR	SR	PR
8	M	151	157	5	OD CF 1" OS CA 1"	OD LP OD LP	OD CF 3" OS 2/140	25.0	24.0	--	--	--	--	--	--
9	F	137	119	3	OD 4/200 OS 2/100	OD 2/140 OS 2/140	OD 5/140 OD 3/140	21.0	42.5	--	--	--	1.7	--	--
10	M	101	89	1	OD -- OS Obj.P.	OD -- OS CF 14"	OD -- OS CF 14"	17.5	36.0	--	--	--	--	--	--
Means		120.7	115.3	2.8				36.45	46.5						
Standard Devia-tions		19.4	24.0					12.77	10.70						

Identifying Characteristics of Control Group

Subject	Sex	CA (in mos.)	MA (in mos.)	Grade Placement	Distance Acuity	Near Acuity		Discrimination Test Scores		Gates Reading Grade					
										Pre			Post		
						Pre	Post	Pre	Post	WR	SR	PR	WR	SR	PR
1	F	143	139	5	OU 5/400	--	OU 4/200 (Snellen)	54.0	54.5	--	--	--	1.55	--	--
2	M	138	119	5	OU CF 4'	--	OD -- OS 2/140	51.0	44.0	--	--	--	2.27	--	--
3	M	154	165	4	OU CF 8'	--	OD 2/70 OS --	47.0	51.0	--	--	--	--	--	--
4	M	122	122	3	OU CF 1'	--	OD 3/140 OS 1/140	44.0	48.5	--	--	--	--	--	--
5	F	118	105	2	OD 10/400 OS MO	--	OU 2/200 (Snellen)	42.0	48.5	--	--	--	--	--	--
6	M	145	144	3	OU 4/200	--	OD MO OS 3/140	41.0	46.5	--	--	--	--	--	--
7	M	135	117	2	OU MO	--	OD 2/140 OS --	27.0	24.5	--	--	--	--	--	--
8	F	121	97	2	OU CF 2'	--	OU 1/200 (Snellen)	27.0	19.0	--	--	--	--	--	--
9	F	127	109	3	OD -- OS CF 2'		OS 1/200 (Snellen)	17.0	13.0	--	--	--	--	--	--
10	M	81	79	1	OU LP	--	OD -- OS 2/140	13.0	17.0	--	--	--	--	--	--
Means		128.4	119.4	3.0				36.2	36.65						
Standard Deviations		20.25	25.30					9.635	16.19						

Table 18

Identifying Characteristics of Print Comparison (Criterion) Group

Sub-ject	Sex	CA (in mos.)	MA (in mos.)	Grade Place-ment	Distance Acuity	Near Acuity		Discrimination Test Scores		Gates Reading Grade	
						Pre	Post	Pre	Post	Pre PPR	Post PPR
1	M	126	125	3	OD 10/200 OS 16/200	OD 16/140 OS 16/140	OD 14/200 OS 14/200	56.5	57.5	2.4	2.33
2	F	141	149	4	OD MO OS 12/200	OD MO OS 14/70	OD CF 14" OS 7/140	56.0	55.5	4.1	4.4
3	M	114	122	3	OD CF 4' OS 20/200	OD 3/140 OS CF 10"	OD CF 14" OS 10/140	54.5	57.0	2.83	3.2
4	M	111	96	3	OU 6/200	OD 14/47 OS 14/140	OD 14/70 OS 10/140 OU 14/47	54.0	54.0	2.6	2.83
5	F	99	100	2	OD 8/200 OS 6/200	OD 6/140 OS 4/140	OD 6/140 OS 6/140 OU 7/140	53.0	55.0	3.2	2.78
6	M	101	100	3	OD 5/200 OS --	OD 7/140 OS LP	OD 10/140 OS LP	51.5	55.0	2.4	3.2
7	M	87	97	2	OD 10/200 OS 20/200	OD 8/140 OS 8/140	OD 7/140 OS 10/140 OU 12/140	51.0	55.0	2.5	2.7

Identifying Characteristics of Print Comparison (Criterion) Group (Continued)

Subject	Sex	CA (in mos.)	MA (in mos.)	Grade Placement	Distance Acuity	Near Acuity		Discrimination Test Scores		Gates Reading Grade	
						Pre	Post	Pre	Post	Pre PPR	Post PPR
8	M	112	110	3	OU 4/200	OD 6/140 OS 6/140	OD 8/140 OS 5/140	44.0	51.0	2.33	2.4
9	M	139	122	3	OD LP OS 2/200	OD LP OS 2/140	OD -- OS 3/140	43.0	48.5	2.3	2.27
10	F	90	82	1	OU Obj.P.	--	OD CF 6" OS CF 14"	33.0	38.0	1.5	1.5
Means		112	108	2.7	--	--		49.65	52.7	2.62	2.76
Standard Deviations		18.77	18.13	6.13				11.51	5.82	2.14	